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ABSTRACT

The objectives of this Congressional hearing on high definition information systems were: (1) to receive testimony on standards for systems that permit interoperability between the computer, communications, and broadcasting industries; (2) to examine the implications of the Grand Alliance, an agreement by high definition television (HDTV) proponents to pool their efforts to produce a single system for resurrecting a domestic manufacturing capability and related consumer electronics equipment and components; and (3) to determine the role of government in supporting the development of technologies important to high definition information systems. Testimony was received from Michael Liebhold, Media Architecture Research, Apple Computer, Inc.; Branko J. Gerovac, Advanced Technology, Communications, Entertainment, and Media Business Unit, Digital Equipment Corp.; Robert M. Rast, HDTV Business Development, General Instrument Corp.; James Carnes, David Sarnoff Research Center; Robert K. Graves, Video Technology/Infrastructure, American Telephone and Telegraph; Howard Miller, Broadcast Operations, Engineering, and Computer Services, Public Broadcasting Service; Robert C. Hummel, Animation Technology for Walt Disney Television Animation; and W. Russell Neuman, Murrow Center, Tufts University. Additional material submitted for the record is appended. (KRN)

HIGH DEFINITION INFORMATION SYSTEMS

HEARING

BEFORE THE

SUBCOMMITTEE ON TECHNOLOGY, ENVIRONMENT AND AVIATION

OF THE

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY U.S. HOUSE OF REPRESENTATIVES

ONE HUNDRED THIRD CONGRESS

FIRST SESSION

JUNE 24, 1993

[No. 30]

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*Ranking Republican Member.

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WITNESSES

HIGH DEFINITION INFORMATION SYSTEMS

THURSDAY, JUNE 24, 1993

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY,
SUBCOMMITTEE ON TECHNOLOGY, ENVIRONMENT AND AVIATION,
Washington, D.C.

The Subcommittee met, pursuant to call, at 9:36 a.m., in room 2318, Rayburn House Office Building, Hon. Anna G. Eshoo [acting chair of the Subcommittee] presiding.

Ms. ESHOO (presiding). Good morning, everyone.

Without objection, this hearing will be open to print coverage, video, and still photography.

Welcome to the panel and everyone that is here.

The Subcommittee meets today to hold this hearing on high definition information systems. We are using the term "high definition information systems" rather than "high definition television," or HDTV, to emphasize the desirability of development of a standard for over-the-air television broadcasting that permits interoperability between the computer, communications, and broadcasting industries.

One of our objectives this morning is to receive testimony on whether the standard proposed by the Grand Alliance provides this interoperability. The Alliance is an agreement by the remaining HDTV system proponents who responded to a 1987 Federal Communications Commission rule-making on advanced television to pool their efforts to produce a single system to propose as the next U.S. television standard.

Another objective of this hearing is to examine the implications of the Grand Alliance for resurrecting a domestic U.S. manufacturing capability in consumer electronics equipment and components needed for high resolution production, transmission, and display. We are also interested in the views of witnesses on whether there is a role for Government in supporting the development of technologies important to high resolution information systems.

Although I am a new member of this Subcommittee and on the Science, Space, and Technology Committee, it is my understanding that the Committee and its Technology Subcommittee have longstanding interests in this issue. When the Science Committee held its first hearing on this subject in March 1989, the Committee urged that the FCC adopt an over-the-air television transmission standard based on digital technologies rather than following the path of Japan and the European Community in adopting an analog standard. Witnesses argued that commercial development of digital

technologies in a system which accommodated both entertainment and nonentertainment uses presented the best possibility for the United States companies to regain a market share in consumer electronics.

At the time of the Committee's 1989 hearing, all the systems submitted to the FCC for consideration were analog systems. The first all-digital system was proposed in June of 1990. More quickly followed. By the time of the announcement of the Grand Alliance, all of the remaining proponent systems were fully digital.

The Federal Communications Commission and its Advisory Committee on Advanced Television Service have given serious attention to the compatibility of a terrestrial broadcast standard with computer imaging. Much of the debate has centered on progressive scanning and square pixels needed by the computer industry versus interlaced scanning and rectangular pixels currently used by our broadcasting industry. The last report of the Advisory Committee found that "a transmission format based on progressive scan and square pixels is beneficial to creating a synergy between terrestrial advanced television and national public information initiatives, services, and applications."

A witness from the FCC testified before this Subcommittee in March of this year that proponents would need to design and document a migration path that would result in a highly interoperable system based upon progressive scanning and square pixels. The announcement by the Grand Alliance states that the "long term" standard it is proposing will be progressive but that the system initially will be both interlaced and progressive. Since, as the old saying goes, "The devil is in the details," we hope to receive testimony at this hearing on why the standard is initially a hybrid, the time frame for implementing an exclusively progressive standard, the implications for our television and computer industries, and the implications of this standard for revitalizing U.S. manufacturing capabilities in products needed for high resolution production, transmission, and display.

We have with us this morning two panels of distinguished witnesses. The first panel consists of representatives of the computer industry and representatives of the Grand Alliance. They are Mr. Michael Liebhold of Apple Computer, Inc., Mr. Branko Gerovak of Digital Equipment Corporation, Mr. Robert Rast of General Instrument Corporation, Dr. James Carnes of the David Sarnoff Research Center, and Mr. Robert Graves of AT&T.

A representative of the U.S. broadcasting industry, Mr. Howard Miller of the Public Broadcasting Service, is on our second panel. And he is joined, or will be joined, by Mr. Robert Hummel of Walt Disney Television Animation and Professor W. Russell Neuman of Tufts University.

I want to thank all of the witnesses for being with us today. I also want to remind them that they should try to limit their oral statements to five minutes so that we will have ample time for discussion. I hope that mine have been held to that as well.

I would now like to recognize the ranking minority member. He is not here though. But when he comes, we will recognize him and welcome him—he is Mr. Lewis from Florida—and invite him at

that time to make any opening statement that he would wish to make.

So good morning.

Mr. Roemer, my distinguished colleague, would you like to make an opening statement?

Mr. ROEMER. Just very briefly, and first of all to congratulate you, who we are in very good hands with, our honorable and distinguished chairperson this morning from the great State of California.

Ms. ESHOO. Thank you.

Mr. ROEMER. I would like to welcome our witnesses as well this morning on a very interesting and timely topic. So often times on this Committee, we hear abbreviations and acronyms and fancy words for different things. We have heard about maglevs and EV's and HDTV, and we are delighted that so many times those kinds of acronyms and abbreviations stand for electric vehicles and high definition television and magnetic levitation trains because those are exactly the types of things that translate into enhanced U.S. competitiveness, rebuilding our manufacturing base, and more jobs for Americans. They also translate into doing something about our trade deficit at some point down the line.

So I am delighted to see our business representatives here today. I will be very interested in hearing what you have to say in three different areas: on technology and standards; on our international competitors, and where particularly the Japanese are in this process; and, finally, how our collaborative efforts are proceeding; and, again, I just want to thank you for your time and salute you for your efforts, and I hope we continue to progress well in this area.

Thank you.

Ms. ESHOO. Thank you.

I would like to recognize the gentleman from New Jersey, Mr. Zimmer, and ask if he would like to make an opening statement.

Mr. ZIMMER. I certainly would.

Thank you, Madam Chairman. It is a real pleasure to be here for this hearing and to be joined by two representatives from New Jersey from our high-tech sector in the State. The Route 1 corridor is known at least in New Jersey and will soon be known worldwide as Video Valley because of the work that has been done in HDTV, and not far from there, of course, is the AT&T facility in Basking Ridge, which is right across the line from my current Congressional district.

So I want to welcome Dr. Carnes and Mr. Graves here for the testimony that they are going to give. I look forward to the description of how this Grand Alliance is going to work and how we are poised to make this Nation and our private sector a leader in an emerging area of technology.

Thank you very much.

Ms. ESHOO. Thank you.

I invite my colleague, the gentleman from New Jersey, Mr. Bartlett, to make an opening statement—I mean from Maryland. I'm sorry.

Mr. BARTLETT. Thank you very much. I am very happy to be here. I look forward with anticipation to the presentations and to

the discussion which follows, and I will reserve my comments until that time.

Thank you very much.

Ms. ESHOO. Thank you.

We would like to start with Mr. Liebhold, who is with a very distinguished company that I have the privilege of representing in my Congressional district, Apple.

STATEMENTS OF MICHAEL LIEBHOLD, SENIOR SCIENTIST, MEDIA ARCHITECTURE RESEARCH, APPLE COMPUTER, INC., CUPERTINO, CALIFORNIA; BRANKO J. GEROVAC, MANAGER, RESEARCH AND DEVELOPMENT, ADVANCED TECHNOLOGY, COMMUNICATIONS, ENTERTAINMENT, AND MEDIA BUSINESS UNIT, DIGITAL EQUIPMENT CORPORATION, MAYNARD, MASSACHUSETTS; ROBERT M. RAST, VICE PRESIDENT, HDTV BUSINESS DEVELOPMENT, GENERAL INSTRUMENT CORPORATION, SAN DIEGO, CALIFORNIA; JAMES CARNES, PRESIDENT AND COO, DAVID SARNOFF RESEARCH CENTER, PRINCETON, NEW JERSEY; AND ROBERT K. GRAVES, VICE PRESIDENT, VIDEO TECHNOLOGY/INFRASTRUCTURE, AT&T, BASKING RIDGE, NEW JERSEY

Mr. LIEBHOLD. Thank you, Madam Chairperson—Chairwoman. I am really delighted to be here today—got it right.

Ms. ESHOO. Some day it won't be awkward.

Mr. LIEBHOLD. We have a historic opportunity to establish an advanced imaging system that is going to serve a broad community of interests in this country. Many of these communities have been identified in discussions surrounding the national information infrastructure, educational communications, educational media, medical communications, medical media, business image communications, professional and scientific communications, and defense communications.

There is an opportunity for the American advanced television standard to offer considerable benefits for the intercommunication between these environments. There are a number of principles a number of people in the computer and imaging and communications industries have been advocating for several years. Interoperability is one; extensibility—that is, the ability to extend a format into the future—and harmonization with other standards.

We are happy to report that the Grand Alliance seems to have adopted in spirit nearly all of the recommendations that many of the communities surrounding the national information infrastructure have advocated. However, there are powerful interests, mainly the video equipment companies, that are advocating an incremental extension of a television standard based on older interlaced technology. In an attempt to reach a compromise, the Grand Alliance has decided to incorporate both progressive scan and interlaced scan into the television system.

Many believe that this will, in fact, result in a de facto interlaced standard since all of the existing equipment for television production and display may be relatively easily modified and brought to market sooner. In fact, there are communities that are arguing—in fact, these same communities of equipment companies are argu-

ing that we need an HDTV by 1996. The only way to have a 1996 HDTV is to incorporate an interlaced television system.

Unfortunately, once in place, an interlaced television system would hold both the creators of the image system and the consumers captive to the de facto standard. So all of the goodness of the progressive elements would have little chance to flower.

There are a number of implications. One of the clearest and simplest examples is a computer display in a classroom. Now a new technology called multi-media is widely used now in classrooms and we expect is going to continue to be used. A simple example of multi-media is, on a computer screen is a page of text with beautiful, readable fonts similar to a textbook, with an illustration on the page, only the illustration is not just a print photograph, it is a live video coming from the satellite, the cable, off a compact disc. The same textbook, electronic textbook, if it were a scientific textbook, might include some live images from the National Center for Supercomputer Applications.

The K-12 classroom is where popular media meets professional media. The cost of interoperability will be borne by the K-12 classrooms. These are preliminary estimates that a television system that is based on interlaced scan would cost a K-12 display to be 20 to 50 percent higher. Likewise, in general, the Grand Alliance proposal to incorporate six different display formats would seem to require that receivers be capable of receiving all of them. That is going to add considerable cost. The right way to do it would be to give a basic display a high quality image, a premium display an enhanced image.

The problem then becomes one of how to incorporate the issues and concerns of the national information infrastructure stakeholder communities that I outlined a few minutes ago—the education community, the medical community, the business image communications community. It is apparent to me that the existing FCC advisory process is not equipped at all to incorporate the considerations of these communities.

The technical advisory process, which is assumed to be an open process, is, in fact, dominated by equipment companies. Already, the technical standard itself is being determined privately in a back room by the Grand Alliance proponents, and the Technical Advisory Committee of the FCC is being chosen quietly in the similar back rooms. This is not an open process.

Now, fortunately, last year this committee had the wisdom to create legislation that instructed the President of the United States to appoint a High Resolution Imaging Advisory Committee. Now, January 19, just prior to his leaving office, General Bush—excuse me—President Bush appointed a list of names to that committee. As far as I know, that committee has never met, and I would like to request today that this committee evaluate how that committee may be reformed and reappointed by the White House and empowered explicitly to review the implications and costs and benefits of interoperability to the national information infrastructure stakeholder community.

Thank you.

[The prepared statement of Mr. Liebhold follows:]

Statement of

Mike Liebhold
Senior Scientist, Media Architecture Research
Apple Computer, Inc.

Hearing Before the
U.S. House of Representatives
Committee on Science, Space, and Technology
Subcommittee on Technology, Environment, and Aviation

Washington D.C.. 20515
June 24, 1993

Apple Computer, Inc.
20525 Mariani Avenue
Cupertino, CA 95014

Advanced Television and the National Information Infrastructure.

Michael Liebhold
June 24, 1993

The development of a U.S. Advanced Television System (ATV) within the FCC standards process offers a rare and historic opportunity to establish a technical framework that will accelerate U.S. leadership in information technologies and stimulate the creation of the National Information Infrastructure (NII).

Interoperability of applications and technologies across a variety of industry sectors is the key to successful implementation of the NII. A well designed ATV standard that will allow interactive information to be easily conveyed, viewed, and manipulated across a variety of consumer and professional settings and applications is essential to the development and wide deployment of the applications that will bring the benefits of the NII to individuals and institutions.

An interoperable ATV standard will accelerate the development of a wide range of new societally valuable information-based products and services based on new combined functionalities of Televisions, telephones and computers.

One of he key technical components of an ATV standard is the image format. Using progressive scan transmission, entire picture frames are transmitted sequentially. Interlace scanned pictures are transmitted scan line by scan line alternatively. In it's final report 2/12/93, to the Federal Communications Commission, the special panel of the Advisory Committee on Advanced Television agreed that:

> "progressive scan / square pixel transmission is considered beneficial to creating synergy and national information initiatives."

Also, In a letter 5/20/93 to the Federal Communications Commission The Computer Systems Policy Project, (representing the Chief Executive Officers of America's 13 largest computer systems companies urged the commission

> ". . .to support maximum interoperability for ATV by adopting a standard based on progressive scan transmission and square pixels.

On the other hand, powerful video equipment companies are are quietly lobbying for an interlace-scan specification. An early, interlaced, format ATV would allow these companies to sell their existing product line of older generation equipment to American broadcasters and cable companies.

The computer industry tried to use interlace scan years ago, but found that the display flicker produced on fine text, lines, and graphics rendered it unusable. We have subsequently learned that ergonomically acceptable information displays require progressive scan.

In an apparent attempt to compromise, The Grand Alliance has announced a preliminary intent to support both interlaced and progressive scan transmission.

A serious protest from MIT (One of the members of the 'Grand Alliance') is included in the agreement and press release:

> "MIT believes that digital video broadcast that exclusively uses progressive scan from the beginning is in the best interest of the United States."

The Grand Alliance is proposing to include a wide variety of formats. These include interlaced and progressive scan, square and non-square pixels, and frame rates of 24, 29.97, 30.0, 59.94, and 60.0 Hz.

Such an approach is claimed to be "interoperable" with all of these formats. However, if all of these formats are used, any given receiving device will need to decode all of them. This adds cost to every receiver by requiring that all formats can be decoded. If a lower cost receiver is offered which only decodes some of these formats, then any programs or services originated in the other formats could not be received. This is the opposite of interoperability.

True interoperability would require that each receiver be able to receive all services and programs. A lower cost receiver should be able to receive all services adequately but with reduced quality. A premium receiver should be able to receive all services at their highest available quality.

Of particular concern are the proposals to include non-square pixels, and interlace. Also of concern are the frame rates of 29.97, 30, 59.94, and 60 Hz, which are somewhat incompatible with the needs of computer displays which require rates in the 70 to 80 Hz range.

The computer industry and other imaging industries -- including suppliers to the health care industry and the education community -- are willing and able to invest immediately in high resolution technologies. Many of these communities are already using or adopting high resolution systems well in advance of the television industry. The wide application of such systems in broadcast ATV will generate economies of scale that will reduce or eliminate the high cost of converting signals across disparate environments. If the Commission establishes a standard broadcast image framework that will allow many communities to share the benefits and economies of scale of sub-component systems, such a system will be widely adopted.

In it's current form, the Grand Alliance compromise could result in a defacto interlaced standard. The new standard will clearly benefit video equipment manufacturers, but offer little value to the many stakeholders of the National Information Infrastructure:

- ~ Educational media and computing
- ~ Medical image communications
- ~ Publishing and page graphics
- ~ Business image communications
- ~ Scientific and Defense image communications

A progressive scan ATV system could provide substantial economic and qualitative advantages in areas that are of critical importance to the future of the United States in the areas of education, health and human services, commerce, and U.S. competitiveness -- and even to the defense of our nation. These communities are already using or adopting high resolution systems well in advance of the television industry. An interlaced- scan ATV standard would inhibit the sharing of the economies of scale of subcomponent technologies.

In Kindergarten through 12th Grade (K-12), computers are becoming a significant tool for improving the efficiency of the educational system. The current computer capabilities include text, color images, interactivity, and some motion video on the screen. A progressive scan ATV could augment these existing capabilities with high quality video images as ATV develops. Classroom computers will increasingly incorporate video connections for remote learning, and text accessed from remote libraries. These improvements can yield a significant improvement in the quality, breadth, and economic efficiency of education.

An electronic textbook in a K-12 classroom is an excellent test for the Interoperability of a proposed system. There is growing evidence that a 'multimedia' textbook will be an effective instructional tool. We can envision a page of text (requiring progressive scan,) a video illustration, and a scientific image (progressive all displayed on the same screen). Educational media includes both 'popular' media and 'professional' media. An all-progressive scan ATV would minimize the cost of converting formats. On the other hand an interlace standard will pass costs on to schools and parents. Interlace and problems with frame rate can result in significant increase in cost for every receiving device. Each classroom receiver would need to do expensive processing to de-interlace and to convert frame rates. The frame rates of 29.97, 30, 59.94 and 60 Hz are intended for a screen display rate of 59.94 or 60 Hz, which has far too much flicker for long-term classroom use. Computer screens must operate at refresh rates in the 70 to 80 Hz range in order to have acceptable flicker for long-term educational use. For such rates, ATV frame rates which are compatible are needed. The rates currently being proposed by the Grand Alliance are not compatible. If This is not changed, there will be a substantial increase in cost and degradation of quality for computer use in the classroom. Estimates of cost increase for each classroom receiver range from 20% to 50% increased cost, if the ATV proposal is not adjusted to be more interoperable. Further, the quality of presentation is significantly reduced, even with the higher cost.

The Grand Alliance claims that channel limitations requires them to transmit interlaced scan. Yet, two weeks ago, at the NCTA (National Cable Television Association) , Zenth Corporation demonstrated <u>two</u> HDTV progressive-scan signals delivered over <u>one</u> 6mnz video channel. There is clearly enough channel capacity in cable systems serving a majority of Americans to eliminate any need for interlace-scan. The broadcast channel does , indeed, suffer from greater signal interference - but it currently serves a diminishing audience of viewers.

The Process:

The existing Advisory Committee on Advanced Television must carefully consider whether it is really a good idea to require viewers, cable companies and broadcasters to invest billions in an interim ATV implementation that is already considered obsolete by a very significant majority of technical experts.

The costs of interoperability need to be justified by the Grand Alliance.

The current Advisory Committee on Advanced Television is not equipped in any way to evaluate the benefits of the Grand Alliance System to NII constituencies.The Advisory committee is dominated by equipment vendors, and has no representation whatsoever from NII stakeholder communities.

- ~ Educational media and computing
- ~ Medical image communications
- ~ Publishing and page graphics
- ~ Business image communications
- ~ Scientific and Defense image communications

This committee anticipated the need for a separate independent advisory. Late in 1991, Congress passed legislation (authored by this committee) instructed the President to form an Advisory Commission on High Resolution Imaging Systems. within the White House Office of Science and Technology Policy. On Jan. 19, 1993, (a day before the Clinton Inauguration) President Bush appointed a list of people to serve on the Advisory. As far as I know that group has never convened.

Summary

The grand alliance makes things simpler - there's the private interest of 'the commercial proponent' and there's the public interest.

I urge this committee to quickly investigate and advise the president on how to re-form and empower the Advisory Commission on High Resolution Imaging Systems to investigate and report on costs of interoperability of the Grand Alliance System to NII constituencies as well as ensuring the role NII stakeholder communities in the design and testing of a US ATV.

There should be no question that interoperability is an essential element of the U.S. Advanced Television Standard.

Computer Systems Policy Project

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James G. Treybig Tandem

James A. Unruh Unisys

Kenneth R. Ku, Executive Director
1735 New York Avenue, NW Suite 500
Washington, DC 20006
202 628-1700 (Fax) 202 331-1024

May 20, 1993

The Honorable James H. Quello
Chairman, Federal Communications Commission
1919 M Street, N.W.
Washington, D.C. 20554

Dear Chairman Quello:

As the Federal Communications Commission approaches a critical crossroads in its Advanced Television System (ATV) standards process, the Computer Systems Policy Project (CSPP) urges you to establish a technical framework for ATV based on maximum interoperability. Such a decision will accelerate U.S. leadership in information technologies and stimulate the deployment of an enhanced National Information Infrastructure (NII).

CSPP described its vision of the NII, potential applications in healthcare, education, manufacturing, and access to information, and key policy principles for achieving the NII in its January 1993 report, Perspectives on the National Information Infrastructure, which I am enclosing. In that report, we noted that interoperability of applications and technologies across sectors is the key to successful implementation of the NII. A well designed ATV standard that will allow interactive information to be easily conveyed, viewed, and manipulated across a variety of consumer and professional settings and applications is essential to the development and wide deployment of the applications that will bring the benefits of the NII to people and businesses.

I am attaching a brief description of the key technical requirements for an interoperable ATV standard that will support the applications described in CSPP's paper and accelerate the development of a wide range of new information-based products and services. In brief, we believe that progressive scan transmission and square pixels are two of the critical factors necessary to achieve a fully interoperable ATV.

The Commission has an opportunity to select an interoperable ATV standard that all sectors can embrace. If a non-interoperable standard is selected, even on an interim basis, this may delay the widespread adoption of ATV by initiating a process to develop a

second standard that all industries would be able to use. It is quite possible that many broadcasters would wait for the completion of this second, superior and more useful standard.

The Computer Systems Policy Project urges you to support maximum interoperability for ATV by adopting a standard based on progressive scan transmission and square pixels.

Thank you for your consideration.

John Sculley
Chairman
Computer Systems Policy Project

Enclosures

cc: Representative Ed Markey
Representative George Brown
Representative John Dingell
Senator Ernest Hollings
Senator Daniel Inouye

KEY REQUIREMENTS FOR AN INTEROPERABLE ATV STANDARD
The Computer Systems Policy Project
May 20, 1993

The findings from the interoperability review conducted by the Federal Communications Commission's Advanced Television Advisory Committee point out that progressive scan and square pixels are critical factors to achieve a fully interoperable ATV.

Progressive Scan (non-interlace)

The computer industry tried to use interlace scan years ago, but found that the display flicker produced on fine text, lines, and graphics rendered it unusable. We learned that ergonomically acceptable information displays require progressive scan. Interoperability will be made unnecessarily difficult and expensive -- and less effective -- if interlaced ATV images have to go through a scan conversion process whenever they are used outside the entertainment domain. Likewise, flicker problems on interlaced ATV receivers connected to future information highways will severely compromise their ability to display text, line, or graphics information. For these reasons, progressive scan transmission is essential for interoperability.

The use of interlace in advanced television systems, as some propose, could cause a serious dilution of the renaissance of a new U.S. digital video communications industry. On the other hand, a system based on progressive scan would stimulate a new array of products and services.

An interoperable, long-lived standard at a minimum requires the transmission signal to be progressive scan -- regardless of whether in the short term the two extreme ends of the delivery chain (cameras and displays) remain interlace with de-interlacing occurring in or near the camera before transmission and with scan reduction occurring at the display.

Square Pixels

The computer and information industries have standardized on square pixels. Square pixels allow lines and shapes to appear smooth and well formed when manipulated by digital circuitry. The conversion process for square/non-square pixel representations is inexact and inefficient and degrades image quality. Any ATV system that uses non-square pixels will seriously compromise interoperability.

Other Factors

We recognize that the development of ATV continues to make progress and that all proponents continue to improve their systems. The proposed standards are all digital, and all remaining proponents have committed to a flexible packetized data transport structure and universal headers/descriptors. This approach is necessary for the long term success of the standard. Only a digital ATV solution that is flexible, with open interfaces, will provide benefits to both the computer and television industries. There must be no obstacles in the form of proprietary components in the standard.

Because ATV systems consist of several components, considering these components separately will make it easier for the U.S. to influence worldwide standardization. Five components that must be defined with open interfaces are: 1) audio/video capture; 2) audio/video data compression; 3) signal distribution; 4) audio/video data decompression; and 5) displays.

In addition, there are other interoperability and extensibility issues, identified in the Advisory Committee's interoperability review, which the Commission should address in conjunction with the computer industry in the near future.

Interoperability is Important to Stimulate Wide Adoption

The computer industry and other imaging industries -- including suppliers to the healthcare industry and the education community -- are willing and able to invest immediately in progressive scan technologies. Many of these communities are already using or adopting high resolution systems well in advance of the television industry. The wide application of such systems will generate economies of scale that will reduce or eliminate the high cost of converting signals across disparate environments. Such wide adoption will make its application more affordable for broadcasters in the future. If the Commission establishes a standard broadcast image framework that will allow many industries to share the economies of scale of sub-component systems, such a system will be widely adopted. If a broadcast standard is chosen that is not interoperable, most certainly another process will have to be initiated to develop a harmonious architecture.

Summary

By taking the above considerations into account when selecting an ATV standard, including an interim standard, the Commission will ensure the adoption of a forward-looking standard that will be broadly extensible to many industry sectors and applications and will accommodate future technology trends that we cannot predict today.

TOTAL P.005

FCC ACATS
Special Panel Report

EXECUTIVE SUMMARY

This document represents the work conducted to date under the auspices of the Advisory Committee on Advanced Television Service, which was formed in 1987 to advise the Federal Communications Commission on various aspects of advanced television. Through the efforts of hundreds of Advisory Committee participants, particularly those groups which have proposed systems for the Committee's consideration, extraordinary achievements in advanced television have been realized in a very short period. As a result of the Advisory Committee process, under the Commission's leadership, it has become apparent that digital high definition television service is achievable for the United States.

Testing and data analysis recently were completed on five high definition television systems. Previously, in its Fifth Interim Report to the FCC, the Advisory Committee approved a set of ten "Selection Criteria" for use in analyzing the performance of the systems tested. The criteria are grouped into three general categories: spectrum utilization, economics, and technology. In the same report, the Advisory Committee created a Special Panel that would use these criteria to evaluate the performance of tested ATV systems.

The Special Panel met on February 8 - 11, 1993, to consider these matters and to pass a report to the Parent Committee for its consideration. The resulting findings, the bases of which are set forth in Chapter 14 of this document, are as follows:

SPECTRUM UTILIZATION

1. The analysis conducted by the Advisory Committee clearly demonstrates that a substantial difference exists in spectrum utilization performance between Narrow-MUSE and the four all-digital systems. The differences among the four digital systems generally are far less pronounced, however. Based on this analysis, it would appear that Narrow-MUSE will not prove to be a suitable terrestrial broadcasting ATV system for the United States.

2. The Special Panel notes that many system proponents have proposed improvements to their systems in the area of spectrum utilization. The Special Panel finds that the system improvements, primarily those identified by its Technical Subgroup as ready for implementation in time for testing, may lead to improvements in spectrum utilization and should be subjected to testing as soon as possible.

3. The Special Panel finds that the degree of interference from ATV into NTSC, as reflected in the test results and the PS/WP3 report, is recognized as an area of concern in certain markets. The Special Panel finds that the issue of ATV into NTSC interference, including interference to BTSC audio, should be addressed in the remaining stages of the system selection process, including the examination of refined allotment/assignment techniques, the study of possible beneficial effects of system improvements, and the consideration of any mitigations which might be achieved by transitional implementation policies.

ECONOMICS

1. No significant cost differences among the five proponent systems, either in costs to consumers or to broadcasters, are evident. Thus, based on cost alone, there is no basis to discriminate among systems. However, the additional benefits offered to broadcasters and others by the digital systems were noted as significant.

TECHNOLOGY

1. As a result of the testing process, the Advisory Committee is confident that a digital terrestrial advanced television system can provide excellent picture and sound quality. All of the system proponents have proposed refinements that are likely to enhance the audio and video quality beyond that measured in the testing process.

2. A variety of transmission formats was evaluated. The transmission robustness analysis conducted by the Advisory Committee clearly reveals that an all-digital approach is both feasible and desirable. All of the system proponents have proposed refinements that are likely to enhance robustness beyond that measured in the testing process.

3. An all-digital system approach is important to the scope of ATV services and features and in the areas of extensibility and interoperability. All four digital proponents have committed to a flexible packetized data transport structure and universal headers/descriptors; design and implementation are subject to verification.

Progressive-scan/square-pixel transmission is considered beneficial to creating synergy between terrestrial ATV and national information initiatives. As well, scalability at the transmission data stream would permit trade-offs in "bandwidth on demand" network environments.

RECOMMENDATIONS

While all the proponents produced advanced television systems, the Special Panel notes that there are major advantages in the performance of digital HDTV systems in the United States environment and recommends that no further consideration be given to analog-based systems. The proponents of all four digital HDTV systems -- DigiCipher, USC-HDTV, AD-HDTV, and CCDC -- have provided practical digital HDTV systems that lead the world in this technology. Because all four systems would benefit significantly from further development, the Special Panel does not recommend any one of these systems for adoption as a United States terrestrial ATV transmission standard at this time. Rather, the Special Panel recommends that these four finalist proponents be authorized to implement their improvements as submitted to the Advisory Committee and approved by the Special Panel's Technical Subgroup.

The Special Panel further recommends that the approved system improvements be ready for testing not later than March 15, 1993, and that these improvements be laboratory and field tested as expeditiously as possible. The results of the supplemental tests, along with the already planned field tests, would provide the necessary additional data needed to select a single digital system for recommendation as a United States terrestrial ATV transmission standard.

Ms. ESHOO. Dr. Gerovac. Am I pronouncing your name correctly?

Dr. GEROVAC. Good.

My name is Branko Gerovac. I am in corporate research at Digital Equipment Corporation and am also responsible for advanced technology in our communications, education, and media business area, and I'm also a visiting scientist at MIT's Media Laboratory.

In terms of my other activities, I have been involved with HDTV officially for Digital Equipment for about six years. I have been following HDTV for almost 20 years for professional and personal interests, and I have been involved in intermixing computers with video and audio and film for 10 or 15 years.

Currently, I am a member of the FCC's Advisory Committee special panel that is reviewing the advanced television proposals and am a member of the technical subcommittee that will be reviewing the Grand Alliance proposals, and also a member of the planning subcommittee that drafted the interoperability report for the Advisory Committee, and I'm also involved in SMPTE activities, which contribute to the definitions that are occurring for advanced television.

I want to thank the chair and the Subcommittee for providing this opportunity to talk about this issue. It is very important, and I commend the Committee for recognizing the implications and the importance of high resolution systems and the national information infrastructure.

I won't read my testimony in written form, it is here for inclusion, but there are a few points that I wanted to make. I'll borrow a phrase that I attribute to William Shriver from MIT. HDTV is not just about television, it really is about a number of things that are changing the landscape around technology and how services are provided. The convergence among industries, among computing, communications, media of all forms, has been talked about for several years now. If you look at the news, just in the past month you can see the impact that this is having on people's day-to-day thinking.

What we decide to do for HDTV is going to be pivotal in defining the national information infrastructure, and in so doing it is going to be establishing areas that are of critical interest to the United States in education, health care and human services, competitiveness for large and small business, how we conduct science, and it will have a beneficial impact on our personal lives.

The keys that unlock this full benefit of interactive information infrastructure are interoperability, extensibility, scaleability. These ideas have been around for a while, and they are defined in my written comments, they are defined, as you mentioned, in the Advisory Committee reports and the interoperability report that was done for the Advisory Committee.

An interoperable system would permit more rapid deployment of the advanced television services and an information infrastructure by the cost benefit of sharing the deployment with business and with entertainment. In combination, those will drive down the cost much more rapidly. Interoperability services—interoperability will permit advanced services, things that I enjoy as someone who works in a large company, has access to a lot of electronic informa-

tion—it will permit that kind of access to be universally available to people rather than just a privileged few that can afford it now.

Another point is interoperable advanced television system must be deployed sooner rather than later. There are a lot of other forces at work within people that are operating within the computer network environment, within other communications environments, that will deploy an interoperable system in time anyway. Now a noninteroperable system would be supplanted by these other activities that would occur, and those will end up creating costs by partitioning the environment again into the interoperable and noninteroperable components.

The notion of a Grand Alliance is a step forward in this. It promises to move the decision and design process from a competition to a collaboration, a sharing of good ideas and skills. At this point, the Grand Alliance appears to adopt many of the interoperability criteria as they have been listed. We are still early in the process. There is a meeting next week by the technical subcommittee of the Advisory Committee that is looking at the first steps of the Grand Alliance definition.

However, there is one area where there is some ambiguity in the Grand Alliance proposal, and that is progressive scan and square pixels. Though there is an accommodation for them, there is an issue as to what a minimally compliant advanced television system would be and how progressive scan would be accommodated in that minimally compliant system. Of course, we will have the opportunity next week to go through some of these details and over the next few months to do this.

So in closing, Madam Chair and the Committee, you can provide some guidance to the process by establishing the importance of interoperability of advanced television service with the national information infrastructure and the importance of progressive scan and square pixels to that interoperability.

Thank you.

[The prepared statement of Dr. Gercvac follows:]

Digital Equipment Corporation
1331 Pennsylvania Avenue
Washington, DC 20004

digital

Statement of

Branko J. Gerovac Research and Development, Advanced Technologies Communications, Education, and Media Business Unit Digital Equipment Corporation

Hearing on High Definition Information Systems

Committee on Science, Space, and Technology

U.S. House of Representatives

June 24, 1993

I thank the Chairman and the Committee for the opportunity to discuss the important topic of Advanced Television Service (ATV), and I commend the Committee's recognition of the technological, economic, and social implications of the ATV transmission system.

ATV can and must be much more than the delivery of high resolution entertainment to the home. It is not an overstatement to say that the outcome of the FCC's process to define ATV has crucial implications to future technology innovation, U.S. competitiveness, and this nation's information infrastructure.

ATV technology can produce substantial economic benefits and enhance our quality of life. It can improve education, expand the availability of advanced health care and human services, promote the productivity of our commercial enterprises, and make our government more efficient and effective. To do so, however, the ATV system adopted in this country must be both "interoperable" and "extensible"

Let me explain what I mean. Interoperability, at bottom, means the extent to which TV transmission technology can work effectively with telecommunications and computer technologies. Extensibility refers to the ability of an ATV transmission system to support and incorporate new functions and future technological advances. The technical attributes of interoperability and extensibility are described in the background information submitted with my testimony and are further discussed in the FCC Advisory Committee's December 11, 1992 report on interoperability. Suffice it to say, however, that interoperability and extensibility are keys to making data, images and video information

widely available across the full range of consumer and business settings, in a form that is easily conveyed, viewed, and manipulated.

A paramount benefit of an interoperable and extensible ATV system is that such a systea likely could be deployed more expeditiously than a non-interoperable system -- and expeditious deployment is critical. An interoperable system will support a variety of early applications. In turn, the availability of an expanded range of services will increase demand and thereby reduce costs. Thus, an interoperable ATV system should be more affordable more quickly, and therefore more rapidly accepted in the marketplace, than a non-interoperable system.

Given the desirability of expeditious deployment, the formation of the Grand Alliance is a major step forvard. It moves the process from a competition to a collaboration and thereby increases the chances of early ATV implementation, as long as the consensus system satisfies interoperability requirements.

At this point, it appears that the Alliance's technical proposal incorporates many features important to interoperability, although it is too early to knov with certainty. The Advisory Committee's Technical Subgroup will meet next week to reviev the current status of the proposal and to provide feedback and recommendations to the Alliance.

Let me delve briefly into some of the technical details, because they are central to the ultimate policy goal of and advanced, widely available information infrastructure. The Grand Alliance has proposed the eventual exclusive use of critical attributes of an interoperable system, including high line number, high frame rate, and progressive scanning. Questions have been raised, hovever, about the technical "migration path" to

reach that goal. Other features important to interoperability also are incorporate -- many of which were considered impossible or unnecessary a short time ago. These features include digital signal transmission, data structured in "packets," and a highly flexible data stream. Detailed review may be needed to validate these features, but their importance is not disputed.

The Alliance proposes some near-term use of progressive scanning and square pixels -- which are essential elements of an interoperable ATV system -- but it is unclear to what extent. The key issue for interoperability and the information infrastructure is what constitutes minimal compliance. The favored compromise position is progressive scan format in the transmission channel, not necessarily in the display, as is noted in the FCC Advisory Committee reports. continued reliance on interlaced scanning -- the historical approach used in current TV transmission -- would greatly hinder interoperability, diminish the capabilities of ATV, and weaken the information infrastructure.

Thank you.

Background

Convergence

Computing, communications, and media (including consumer electronics) are adopting a common set of base digital technologies. The common technology base and the economies of scale in the marketplace are driving the industries together. The result is much more than a simple technological leverage across industries, which was called the "technology food chain" (c.1988). Instead, there is an impending interplay and merger of the industries, products, and services themselves.

This convergence is now broadly accepted as inevitable. One needs only to look at recent issues of the Wall Street Journal, Fortune, Business Week, Newsweek, etc. to find articles providing views on the convergence and cross-industry developments. (The convergence theme is appearing in industries' conferences.)

A couple of years ago, the situation was often characterized as a collision among the industries. It was (and to some extent still is) uncertain how businesses adapt to and succeed in the convergence. Thus, convergence was often treated with apprehension due to the change that it brings to all the industries.

Though there is indeed collision with the convergence, it translates into opportunity for those that approach convergence as a new way of looking at their future activities.

The convergence will happen sooner or later. Events have shown that delaying tactics of an individual player or industry have only a temporary effect -- the technological and market drivers are too compelling. Further, recent events have shown that an individual player (or segment of players) can advance the convergence, and can advantageously position themselves.

Evolution

Convergence is not new. In many respects, it's been occurring quietly for many years. For example, seven years ago, the establishment of the MIT Media Lab (and similar efforts) brought attention and focus to convergence.

Throughout the 70s in the computing industry, there was a clear trend toward decentralization -- LSI, minicomputers, departmental computing, timesharing, etc. drove computer industry growth. The 70s also saw the beginning of technology migrating across industry boundaries -- e.g., TV display technology was used for computer graphics displays and desktop video display terminals; consumer analog cartridge tape storage was adopted for data storage; dial-up telephone modems were used for remote access; computers began being used in professional media production, e.g., video editing and newspaper copy writing; and semiconductors enabled pocket calculators.

In the 80s, industries began to show some interplay. The decentralization drive continued as both wide-area and local-area computer networking spread. Microprocessors gave birth to home video games. The cable TV industry with new content providers (e.g., HBO, CNN) mushroomed, and provided greater viewing choices for the individual. Cable TV provided

another wire into the home, higher bandwidth than telephone, albeit still analog and one-way. CDs brought digital sound to the consumer, and totally replaced analog vinyl records. Interestingly, record companies readily embraced CDs, recognizing that they were in the music business, not the vinyl business.

Now in the 90s, the convergence is apparent, and clearly enabled by the move to digital signal processing and communications technologies. The initial pivotal technology was/is ATV. In 1988, the news media focused attention on the potential importance of ATV to core technologies, the technology food chain, and industrial competitiveness. By the beginning of 1990, the full implications of the converging television, communications, and computing industries were promoted, and by the beginning of 1991, all U.S. ATV proponents were digital. Europe and the Pacific Rim are going digital as well. Digital TV (ATV and NTSC) is assured.

In past year, interactive TV and non-couch-potato interactive services are receiving greater recognition. Hence, the emerging pivotal driver is global, interactive, open access, interoperable communications infrastructure for voice, data, images, and video. Or in other words, an international information infrastructure.

It will be driven primarily by a new kind of interoperability. We're approaching a situation where the heterogeneity of content, services, and devices will go well beyond anything that was ever considered. Interoperability will be sought across all generation, transport, and delivery mechanisms, across industry operating styles, etc.

FCC ACATS PS/WP4 Interoperability Review Report

The Interoperability Review findings point out the critical factors and features that are necessary to achieve the full benefits of ATV. All proponent systems incorporate some measure of interoperability. We endorse the Conclusions and Recommendations from the Interoperability Review, and encourage the full suite of recommendations so that the full benefits of ATV are achieved for broadcast and non-broadcast uses. Reinforcing the recommendations:

Digital Implementation -- While digital format is absolutely necessary, simply being digital without providing the other factors is insufficient.

Universal Header/Descriptor (Ref. SMPTE standards effort) -- Given the variety of uses and content and given the rapid development of technology, a universally self-identifying data stream is mandatory to achieve extensibility and longevity of the standard.

Progressive Scan Transmission Format -- The traditional television industry represents the only significant use of interlace scan -- for historic technical reasons. An interoperable long-lived standard at a minimum requires the transmission signal to be progressive scan -- regardless of whether in the short term the two extreme ends of the delivery chain (cameras and displays) remain interlace with de-interlacing occurring in or near the camera before transmission and with scan reduction occurring at the display.

Packetized Data Structure -- Digital communications long ago recognized the benefits of packetized data structures and layered communications protocols for managing the complexity of communications. Digital television will be transported through and among a

variety of media -- terrestrial broadcast, cable, satellite, telecommunication networks, computer networks, and packaged media. To expedite development efforts, to reduce product costs, and to extend features, packetization has proven successful.

Square Pixels (Square Sampling Grid) -- The television industry represents the only significant use of non-square pixels. (The first CRT displays used in the computer industry often used non-square pixels and interlace scan. It was quickly realized that this was not acceptable for ergonomic, picture quality, and computational needs across the variety of uses of picture material.) Square pixels are critical to sharing picture information across industries and uses.

Dynamic Reallocation of the Digital Data Stream -- The full power and potential of a digital data stream comes from the realization that "bits are bits" and that digital data can represent any desired information -- whether moving or still pictures, sound, text, subscriber addresses, ordering and billing, control signals, and so forth without end. Being able to reallocate the data stream to different uses opens up a wide variety of applications, including within terrmstrial broadcast.

Recognition of International Standards -- All industries are moving toward open systems as defined by formal standards. Regardless of whether the origins of a standard are de facto, developed in committee, or mandated, the primary requirement is to avoid establishing arbitrarily non-compliant system features when an existing or emerging standard is available or can be influenced that largely addresses the needs. (For example, ISO is nearing closure on MPEG2, which is largely similar to the ATV proponents' compression/decompression techniques. An international standard would obstruct anti-competitive efforts to partition world markets.)

Modular Architecture and Cost Effective Range of Implementation -- There will be a wide range of devices from very low cost to highly advanced. They will vary across many features -- e.g., black & whitm or color, small to large display, pocket sized to wall mounted, intelligent and interactive. The inexorable advances of VLSI technology, digital signal processing and communication, display technology, etc. will rapidly bring new features and capabilities. The ATV decision needs to endure for several decades in this context of inevitable and continual advances.

Ms. ESHOO. Thank you very much.

I just wanted to state that we are waiting for another colleague, Congressman Paul McHale from Pennsylvania, who is going to sit in this seat. I don't want to interrupt the next testimony. I am going to step out to give some testimony on the glass ceiling, and I think it still exists as I look around this room. I hope that in ensuing years that we will have—I have welcomed the testimony on the part of all the distinguished gentlemen that are here, but it is a reminder that we still have a lot of work to do on this issue. But more than anything else, I wanted to let you know that I would be excusing myself; someone else will step in the chair. The good news is, I'll be back. How's that?

So why don't we go next to Mr. Robert Rast, who is vice president of HDTV business development at General Instrument Corporation.

Welcome, and thank you for being here.

Mr. RAST. Thank you and good morning, Madam Chairman and members of the Committee. I am very pleased to be representing General Instrument here today and our role in digital video compression and transmission. I am also very pleased to be representing the Grand Alliance. Along with my colleagues here who are representing David Sarnoff Research Center and AT&T, there are seven companies in total. The ones who are not directly here today are MIT, North American Phillips, Thompson Consumer Electronics, and Zenith Electronics.

I think the message I would like to say is that from our perspective the HDTV process has come a long way in a short period of time, and I guess we are distressed by some of the phrases that I have heard already: implication that the Advisory Committee is not equipped to serve the interests of the computer industry, the concept that the Grand Alliance system is being crafted privately in a back room, that there won't be public process. I want to assure the Committee that there is a public process in place.

Next week, the Advisory Committee technical subgroup will be meeting to consider the details of the Grand Alliance system, and it will be reviewed in public and may be modified in order to better represent the needs of the various users.

I think one of our messages is that there are a number of different users. There's broadcasters, there's cable, there's satellite and computers, and the problem we have is trying to meet the needs of all the users, and we think we have come a long way in trying to do that.

Branko said that there is an accommodation for progressive scan and square pixels. I think I would like to say that it is far more than an accommodation, it is the centerpiece of our system.

So we think a lot has been accomplished, and we would like to deliver some of that message to you today.

We are very pleased with our perception of the Advisory Committee and what it has accomplished. We think it developed a competitive process. There were 23 different systems; there were six which were actually tested. We think the FCC made some insightful spectrum decisions that helped stimulate the innovation that has occurred. We think the FCC anticipated the need for interoperability from the very beginning. There was focus beyond the broadcast

world, which is what the standard actually addressed. There was focus initially on cable and satellite and with the introduction of digital technology which my company was pleased to foster in June of 1990, there has been an increasing focus on computer applications.

We think last year that innovation and change continued with the Advanced Television Systems Committee which recommended flexible, adaptive data allocation capability and surround-sound, a step up from stereo-sound. The proponents have responded in every case. The other proponents responded by going all digital. It is now clear that we are going to be all digital. We responded last year with inclusion of surround-sound systems, packetized transmission. The Advisory Committee restructured one of its working groups in order to focus on interoperability and the needs of the computer community, and we think we have done a good job in responding to that.

At this point in time, we have got a Grand Alliance system which we think best serves the needs. It takes the best elements of each system instead of declaring any one system to be the best. We think that is the right approach.

We think, as was mentioned, there is a need for consensus now in pulling together. HDTV is not a given. It has got to happen in the marketplace. There is a lot of work, a lot of product development that has got to be tried out. We can't get too far ahead of the marketplace in what we try to accomplish, but we think, and I have included in my testimony some statements about what has happened that has changed and made the HDTV system more responsive to the computer community while at the same time serving the interests of broadcasters, cable, and satellite, and that includes the change to all-digital, it includes using prioritized, packetized data, transport structure with headers and descriptors, lingo words, source adaptive coding, square pixels, and, last but far from least, progressive scan. So we think we are very pleased with what we have been able to accomplish, and we look forward to getting our products into the marketplace.

Thank you.

[The prepared statement of Mr. Rast follows:]

Before the
SUBCOMMITTEE ON TECHNOLOGY, ENVIRONMENT & AVIATION
COMMITTEE ON SCIENCE, SPACE & AVIATION
U. S. HOUSE OF REPRESENTATIVES
Washington, D. C.
June 24, 1993

STATEMENT OF ROBERT M. RAST
GENERAL INSTRUMENT CORPORATION

Good morning, Madame Chairman and members of the committee. I am Robert Rast, Vice President for HDTV Development for the VideoCipher Division of General Instrument Corporation ("GI"). General Instrument Corporation is a member of the Grand Alliance, which was formed by the proponents all-digital HDTV systems for selection of an advanced television standard. General Instrument Corporation is a manufacturer of broadband communications products and has developed digital video compression and transmission technologies for broadcast, cable television and satellite markets. The VideoCipher Division of General Instrument is located in San Diego, California. Other divisions of the company are headquartered in Hickory, North Carolina; Hatboro, Pennsylvania; and Hicksville, New York.

I am joined today by Dr. James Carnes, Vice President and COO of the David Sarnoff Research Center, and Mr. Robert K. Graves, Vice President, Video Technology/Infrastructure, AT&T. Both organizations are members of the Grand Alliance, as are the Massachusetts Institute of Technology, North American Philips, Thomson Consumer

Electronics and Zenith Electronics Corporation.

My purpose this morning is to provide some background which will help your understanding of the technological breakthroughs in digital video compression and transmission which have placed the U.S. in a position of world leadership. Those breakthroughs have occurred in the context of the standards selection process established by the Federal Communications Commission and its Advisory Committee on Advanced Television Service ("ACATS"). I will be followed by Dr. Carnes who will provide you with a more extensive description of the Grand Alliance. Finally, Mr. Graves will discuss some of the economic ramifications of unnecessary delay in the promulgation of the standard.

To set the stage, let me remind you that the television which you watch today is based on the NTSC standard, finalized in the late 1940s. While that standard has been improved, most notably by the incorporation of color in the 1950s, today's television is based on the same fundamental resolution parameters as the original service, including 525 horizontal line, interlace scanning. The introduction of color television, approximately 40 years ago, was the last major advancement in the NTSC standard.

In the early 1980's, Japan's NHK proposed the world wide adoption of the MUSE system, which utilized 1125 horizontal scan lines. MUSE made the world aware of the goal of "high definition television," with quality equivalent to motion pictures, including a wide screen format. The MUSE system renewed concerns in this country about the capabilities

of American technology. Many feared that American companies and American employees would be shut out of a fundamental new technology.

In 1987, at the request of broadcasters, the FCC initiated its rulemaking on advanced television service and established a blue ribbon advisory committee for the purpose of recommending a broadcast standard. Dick Wiley, a former Chairman of the Commission, was appointed to chair this effort and ACATS has become, in some respects, a model for government/industry co-operation.

Several important steps followed:

- ACATS developed a competitive process by which proponents of systems were required to build prototype hardware which would then be thoroughly tested. This process sparked innovation and an entrepreneurial response: initially there were 23 proposals for systems. Hardware was actually built and tested for six systems.

- The FCC made several insightful spectrum decisions which also helped spark innovation. The Commission decided that new ATV systems would share television bands with existing services and would utilize TV channels as presently defined. The Commission also decided that a simulcast approach, as first proposed by Zenith, would be followed. This meant that a new standard could provide a quantum leap forward from the current NTSC standard and would not be hindered by the requirements of the current standard, except to protect existing broadcast service

during a period of transition.

· The FCC anticipated the need for interoperability of the standard with other media. Initially, the focus was on interoperability with cable television and satellite delivery; both were crucial to any broadcast standard. But this acknowledgement of the value of interoperability would also become important to the computer industry when the next technical advance came.

· That happened in June, 1990, General Instrument became the first to propose an all-digital system; that system was subsequently the first to be built and tested. Until then, there had been proposals for utilizing digital compression with analog transmission and proposals for hybrid analog/digital transmission. Although the FCC had said, in the Spring of 1990, that it would reassess technologies in early 1992 to see if all-digital technology was yet feasible, most observers viewed it as at least 10 years in the future. Even after the GI announcement, there were skeptics who said it would not work. I note that the gentlemen sitting with me today, Dr. Carnes and Mr. Graves, were not among those skeptics and the proponents with whom they are associated quickly moved to advocate an all-digital approach.

· The stage was then set for another important step, which was taken in February, 1992, when the Advanced Television Systems Committee ("ATSC") recommended that the new standard include a flexible, adaptive data allocation capability (and that

the audio also be upgraded from stereo to surround sound). Proponents announced the use of packetized transmission, headers and descripters, and composite-coded surround sound (indeed, one proponent, ATRC, had previously adopted packetized transmission). These steps were important for the potential interoperability of these systems with computers. The introduction of all-digital systems had made such interoperability a real possibility.

Six systems (four of which were all-digital) underwent extensive testing in 1991 and 1992 at the Advanced Television Test Center ("ATTC"), in Alexandria, Virginia. Also participating in testing were CableLabs, which tested systems over a cable television test bed, and the Advanced Television Evaluation Laboratory ("ATEL") in Ottawa, Canada. Canadian participation is a reflection of the fact that we are trying to achieve a unified North American standard.

Following testing, the Advisory Committee reduced the number of proponents to those which had built the four all-digital systems: two systems proposed by GI and MIT; one system proposed by Zenith and AT&T; and one system proposed by the ATRC, consisting of Sarnoff, Philips and Thomson. The Advisory Committee decided not to choose from among the four. Testing had shown that each of the systems had some advantages and some disadvantages but there was no single system which was best in all categories of evaluation. Since each proponent had proposed additional improvements, the Committee instead recommended additional testing of those improvements.

By this time, and following encouragement from members of ACATS, proponents had begun to talk about taking advantage of each other's strengths by jointly developing a system which consists of the best features of each individual system. Even as it decided to recommend additional testing, ACATS endorsed the Grand Alliance concept.

Having set a historical perspective, I want to share with you a few observations about what developments to date have meant and what we have learned in the course of the FCC ACATS process and our own development work.

- The Grand Alliance is the right approach. It will help bring the standards selection process to a timely close, allowing U.S. companies to have a central role in developing the new industry and opening up international opportunities. The impact of a U.S. standard will be greatest if we do it as leaders and from a position of strength. If others can be persuaded to follow the U.S. standard, it will create significant global efficiencies which will benefit consumers everywhere. And while the prior process had concentrated on selecting the best system from among those proposed, under the Grand Alliance, the best features of all the systems can be combined to produce a system superior to that of any one of the individual proponents. If HDTV is to be successful in the U.S. and around the world, it will be the result of the contributions of many people and the development of consensus. The Grand Alliance is an example of the spirit of cooperation and consensus.

· Representatives of the computer industry have made significant contributions to the standards process and to the Grand Alliance system which we will build. They participated in the work of ACATS and articulated the need for those features which can enhance the interoperability of an all-digital system. The standard will be better than it would have been thanks to their participation. This Committee encouraged and endorsed that participation and was correct in this approach.

· There is currently a wide gulf of experience between U.S. HDTV proponents and everyone else in the world. The proponent systems, represented by those of us with you today, go beyond the theoretical. We have built hardware; the first four systems in the world. These systems have been extensively tested in the laboratory. We have broadcast HDTV and given public demonstrations of those broadcasts. Among us, we have also done cablecasts, satellite transmissions, and our own field tests. I hasten to add that we have expended our own monies and resources in this endeavor. As a result, we have the world's greatest store of expertise in digital, high resolution compression and transmission. We do not have all the answers but our opinions deserve considerable weight.

· Much has been accomplished, but much work remains. Ideas and prototypes must be turned into products. Those products must be manufactured. Then they must succeed in the marketplace. This requires a conjunction of skills. It also requires capital and incentives. I mention this because some, although by no means all, of

those who have been critical of features of the Grand Alliance proposals, tend to ignore these market disciplines. We want HDTV to succeed and we want to maintain the U.S. leadership position. This requires solutions which are not only sound but which are also practical. It does no good to advocate technologies which are too advanced for current implementation or restrictions which will impose major costs on important market segments.

- A successful standard requires a balancing of interests. Certainly at the outset, and for some years to come, the dominant use for HDTV will be entertainment TV. But we all recognize the desirability of facilitating a merger of entertainment television with computer electronics. The challenge is that, at a time when technology is not sufficiently mature for a perfect accommodation of both interests, we have to draw the right compromise. We believe that the Grand Alliance approach strikes this balance in the correct place.

- Some advocate progressive scanning, and only progressive scanning, for the standard. This creates an area of risk. We must recognize that the production side of progressive scan video programming does not exist. If you are a broadcaster, it would be very difficult to speculate on the timely development of this capability. The approach of the Grand Alliance, which supports the eventual move to all progressive scanning, is to facilitate this migration, to incent, aid and abet it. But to force it, we have concluded, would be unwise.

- Finally, it is important to recognize how far we have come on insuring interoperability of television and computers. Participants from non-broadcast industries suggested a number of significant features for the standard which have come to pass:

  - They sought an all-digital U.S. advanced television standard. It will be.

  - They said that the digital data stream should have a prioritized and packetized data transport structure. The Alliance has announced that this will be the case.

  - They maintained that the standard should include source adaptive coding. It will.

  - They requested that the standard provide for square pixels, to accommodate computer graphics. Square pixels will be included.

  - They requested that the standard utilize a progressive scanning format. The Grand Alliance system includes and endorses progressive scanning and envisions a migration to all progressive scanning.

Ms. ESHOO. Thank you.

We will now go to Dr. James Carnes. Good morning, and welcome.

Dr. CARNES. Good morning, Madam Chair.

My name is James Carnes, and I'm the President of the David Sarnoff Research Center in Princeton, New Jersey. Sarnoff has been a leader in television research since 1942. I am here today as a member and a representative of the industry team called the Grand Alliance.

The members of the Grand Alliance faced a grand challenge as we deliberated on several aspects of the Grand Alliance system—namely, the need to strike the proper balance between competing needs of the broadcast and the computer industries. The most difficult part of that challenge was the picture format which we recognize could have an immense impact on the value and usefulness and the speed of adoption of HDTV and therefore on the competitiveness of U.S. industry, and although we realize that our charge was to develop a terrestrial broadcast standard, we early on had made a commitment to maximize interoperability with computers.

The broadcast and cable industries have valid concerns with regard to picture format. There must be strong consumer demand for HDTV to foster the growth of set manufacture and production of high definition programming which, in turn, can stimulate further technological advances.

Broadcasters need practical, affordable broadcast equipment. Broadcasters also need 1,000-plus-line pictures, and the only feasible way to achieve this today is by using interlace as a compression technique. The subjective testing done during the Advisory Committee testing process showed that 1050 interlaced pictures to be essentially imperceptible in quality from the original uncompressed material. The bottom line is that only interlace can deliver 1,000-plus line, 60-field per second pictures to the home at reasonable cost to the broadcaster and the consumer today.

Now on the other hand, the computer industry needs progressive scan to provide flicker-free performance to reduce eye strain and fatigue over extended periods of computer terminal usage. This is a real need. No one wants to spend eight to 10 hours a day up close doing word processing on an interlaced display.

Now I think everyone agrees, however, with one thing, a 1,000-plus line, progressively scanned, 60-frame-per-second system with square pixels, when practical and cost effective, is the ideal system, and, in fact, a 1,000-plus progressive 60 system is the Grand Alliance goal as soon as practical.

So this is the dilemma we face. The computer industry needs progressive, broadcasters need interlace, and some people wanted both. The solution: Do both. Because we are using digital technology we have that option. This approach accommodates everyone's needs. The Grand Alliance system will support 787 and a half progressive at 60, 30, and 24 frames per second. It will support 1050 interlace, 60 fields per second, and 1050 progressive at 30, 24 frames per second. These are transmission formats. Now this should solve the dilemma.

The fact is, offsets will be capable of receiving and decoding all of these transmission formats automatically, with no action re-

quired by the viewer, and of course this must be the case if we have a standard. We believe the costs to do this per set are relatively minor.

I think some confusion comes in when we talk of display formats as opposed to transmission formats. It is up to the set manufacturer as to whether they want to use interlace, which has somewhat lower cost, or progressive, which is more useful for computers, in their displays. But both types of displays will be usable with all six transmission formats. The marketplace will decide which or both provides the best value, and I think we all agree that the marketplace should be the arbiter of these kinds of decisions.

Now there are other aspects of the Grand Alliance system which enhance interoperability with computers and the telecommunications infrastructure. The Grand Alliance system includes many elements of MPEG 2, a compression approach, which is currently in working draft status in the International Standards Organization. The Alliance system also includes some other capabilities for compression as well, and the proponents are committed to working together to get these capabilities incorporated into the MPEG standard.

Another aspect of the Grand Alliance system which enhances interoperability is the fixed length packet format which provides the flexible delivery of video, audio, text, graphics, and other data which Mike Liebhold spoke of as multi-media. This packet data format provides a high degree of interoperability with other emerging telecommunications and data networks that use similar technology, the important parts of the information infrastructure.

We in the Grand Alliance believe our system is an extremely clever technical solution to a difficult dilemma. I believe the system is the best one for the U.S. consumer and will put America in the forefront both technically and from a competitive business point of view. It contains the best technical attributes of all the previously proposed digital HDTV systems. It creates a collaborate effort with a pool of technical talent and financial resources that will ensure that America is the first to deploy and profit from this important new digital technology. It provides the maximum flexibility required to accommodate both the computer and television industries.

We right now are in an enviable leadership position, and we should move forward quickly to take advantage of it.

This Committee has long led the American charge to technological advance. Your encouragement in the past has done everything from putting a man on the Moon to keeping the nation competitive in the computer marketplace worldwide, and we appreciate your efforts today to help pave the way toward the convergence of television and computing.

Thank you.

[The prepared statement of Dr. Carnes follows:]

Statement of Dr. James E. Carnes

President and Chief Operating Officer

David Sarnoff Research Center

On Behalf of the HDTV Grand Alliance Proponents

Before the Subcommittee on Technology, Environment, and Aviation
Committee on Science, Space, and Technology
U.S. House of Representatives

June 24, 1993

Statement of Dr. James E. Carnes
President and COO, David Sarnoff Research Center

On Behalf of the HDTV Grand Alliance Proponents

Before the Subcommittee on Technology, Environment, and Aviation
Committee on Science, Space, and Technology
U.S. House of Representatives
June 24, 1993

Good Morning, Madam Chairman. My name is Jim Carnes and I am President of the David Sarnoff Research Center in Princeton, New Jersey. Sarnoff has been involved in television research as the central R&D Lab for the RCA Corporation from 1942 until 1987, and for the past six years as a private, client-supported R&D center and subsidiary of SRI International of Menlo Park, California. Sarnoff is proud of its television and communications heritage, which includes the invention of the NTSC Color Standard in use in the United States for the past 40 years. We are equally proud of our more recent pioneering work in the area of high definition television.

I am here today as a member and representative of the industry team called "The Grand Alliance". The members of the Grand Alliance faced a Grand Challenge as we deliberated on several aspects of the Grand Alliance system, namely, the political and technological imperative to strike a delicate and proper balance between competing demands of the broadcast and computer industries and, more importantly, between TV viewers and computer users. The most difficult part of that challenge was the picture format, which we recognized could have an immense impact on the

value and usefulness and speed of adoption of HDTV — and therefore on the competitiveness of U.S. industry. Although we realized that our charge was to develop a terrestrial broadcast standard, we also had made a commitment to maximize interoperability with computers.

The broadcasters and cable industry had valid concerns with regard to picture format. There must be strong consumer demand for HDTV to foster the growth of HDTV set manufacture and production of high definition programming, which in turn, can stimulate further technological advances. This places an initial premium on producing great pictures and compelling programming for TV viewers. For these reasons, the primary objective of the Grand Alliance is to meet broadcaster needs. Broadcasters need practical, affordable broadcast equipment. Many broadcasters also want 1000+-line pictures. And the only feasible way to achieve this today is by using interlace as a compression technique. The subjective testing done during the ACATS process showed 1050 interlace pictures to be essentially imperceptible from the original uncompressed material. Current state-of-the-art progressive cameras are more expensive. The bottom line is that, during the transition to 100% progressive, interlace can deliver 1000+-line 60 field per second pictures to the home at reasonable cost to the broadcaster and consumer now.

On the other hand, the computer industry needs progressive scan to provide flicker-free performance to reduce eye-strain and

fatigue over extended periods of computer terminal usage. This is a real need. No one wants to spend 8-10 hours a day up close doing word processing on an interlaced display!

I think everyone agrees, however, with one thing: a 1000+ line progressively-scanned 60 frame per second system with square pixels, when practical and cost-effective, is the ideal. And, in fact, a 1000+ progressive 60 system is our goal as soon as practical. Unfortunately, the technology has not yet progressed to that point. The main problem is that today we do not know how to compress that much information into a 6 MHz channel. We are doing the next best thing, though, by using progressive wherever we can from the outset as part of a migration path that will lead us to this goal once we develop better compression techniques and IC technology advances that will permit even more computational power per dollar.

So this is the dilemma we faced. The computer industry wants progressive, many broadcasters want interlace, and others want both! The solution: do both. Because we are using digital technology we have that option. This approach accommodates everyone's needs. The Grand Alliance system will support 787.5 progressive at 60, 30 and 24 frames per second. It will support 1050 interlace 60 fields per second and 1050 progressive at 30 and 24 frames per second.

This should solve the dilemma. Broadcasters have their interlace for certain entertainment applications, progressive for others, and computers can use progressive where they need it

The fact is that all sets will be capable of receiving and decoding all formats. This must be the case. We believe the costs per set to make this possible are relatively minor.

I think some confusion comes in when we talk of display formats. It is up to the set manufacturer as to whether they want to use interlace (somewhat lower cost) or progressive (useful for computers) displays. But both types of displays will be useable with all of the 6 transmission formats. The marketplace will decide which, or both, provides the best value. I think we all agree that the marketplace should be the arbiter of these kinds of decisions.

There are other aspects of the GA system which enhance interoperability and the telecommunication infrastructure. The Grand Alliance system includes many elements of MPEG 2 compression approach, which is currently in working draft status in the MPEG Committee of the International Standards Organization. The Alliance system includes other capabilities as well. The proponents are committed to working together to get these capabilities incorporated in the MPEG standard.

Another aspect of the Grand Alliance system which enhances interoperability is the fixed length packet format that provides for flexible delivery of video, audio, text, graphics and other data by broadcast, cable, satellite and fiber. This packet data format provides flexibility and a high degree of interoperability with other emerging telecommunications and data networks that use similar

technology, such as Asynchronous Transfer Mode, or ATM, the emerging standard for broadband telecommunications networks.

We in the Grand Alliance believe our system is an extremely clever technical solution to a difficult dilemma.

I believe the system is the best one for the U.S. consumer and will put America in the forefront both technically and from a competitive business point of view. It contains the best technical attributes of all of the previously proposed digital HDTV systems. It creates a collaborative effort with a pool of technical talent and financial resources that will ensure that America is the first to deploy and profit from this important new digital technology. It provides the maximum flexibility required to accommodate both the computer and television industries. That flexibility will be passed on to the consumer, ultimately the most important user of the technology, who will enjoy new services and applications far beyond the scope and hope of today's television standard. In addition, the Grand Alliance is an exciting new model for corporate cooperation for the mutual benefit of all interested parties. We are in an enviable leadership position and we should move forward quickly to take advantage of it.

This committee has long led the American charge to technological advance. Your encouragement in the past has done everything from putting a man on the moon to keeping the nation competitive in the computer marketplace worldwide. We appreciate

your efforts to help pave the way toward the convergence of television and computing. Thank you.

Ms. ESHOO. Thank you, Dr. Carnes, for assisting us in that, and I would like to call on Mr. Robert Graves next and also ask that my distinguished colleague from New Hampshire, Mr. Swett, take this chair and continue on with the hearing, and, as I said earlier, I shall be back.

Good morning, and please start your testimony, Mr. Graves.

Mr. GRAVES. Good morning, Madam Chair and members of the subcommittee.

My name is Robert Graves, and I am an AT&T vice president responsible for video technology and infrastructure matters. Along with Dr. Carnes and Mr. Rast, I have been involved for several years in the FCC's process for setting an HDTV transmission standard.

I appreciated the opening remarks this morning from the Committee and particularly those of Mr. Zimmer, who is my Congressman, and I appreciate your efforts on our behalf. Thank you.

My emphasis today will be on the need to move with all deliberate speed to establish a U.S. HDTV standard in order to bring the benefits of this technology to the American public as quickly as possible.

Since 1987, with strong support from the Congress and visionary leadership from the FCC and from former FCC Chairman Dick Wiley, who has led the Commission's HDTV Advisory Committee, the U.S. has leapfrogged over earlier analog-based HDTV development efforts in Japan and Europe into a preeminent position in the development of an all-digital HDTV system.

Our recently announced Grand Alliance is an agreement by the remaining HDTV system proponents to produce a single best of the best system. We believe that our proposal, if accepted by the Advisory Committee and the FCC, can save a year or more in the implementation of HDTV by avoiding the risk of ambiguous results from a second round of testing on individual systems and by lessening the possibility of challenges to the FCC's ultimate decision. This will enable the U.S. to maintain and enhance its worldwide lead in the development and commercialization of this vital new technology.

The rapid adoption of an all-digital HDTV system will also promote the creation and maintenance of U.S. high-skilled jobs in the design and manufacture of HDTV receivers, displays, studio and transmission equipment, peripheral equipment and programming, and software development.

At the heart of HDTV will be state-of-the-art integrated circuits, and the development and production of these chips are two areas where many new high-skilled jobs are likely to be created. If major elements of the U.S. standard are applied to other markets around the world, exports of U.S. semiconductors can be substantial.

As for consumers, they will reap the benefits of some of the best technical minds collaborating to bring theater-quality pictures and sound to American homes as well as a host of new applications in home entertainment, education, computer and medical imaging, factory automation, publication, et cetera, all stimulated by the early adoption of this technology.

We believe the Alliance is good news for everyone—consumers, broadcasters, cable operators, the computer and telecommuni-

cations industries, and for U.S. workers. In structuring the proposal, we have kept uppermost in our minds the needs of these groups and incorporated capabilities that are vital to them.

For instance, the system incorporates progressive scan transmission and square pixels, two attributes that are extremely important to the computer industry, including my firm, AT&T, for promoting interoperability with computers and telecommunications. Likewise, needs expressed by many broadcasters have been addressed by including interlaced scan transmission in the initial deployment.

Although speed is of the essence, we want to reassure the Subcommittee that we fully understand that determining the HDTV standard will remain a public and open process. Moreover, whatever standard is adopted, the FCC requires that the applicable technology be licensed to anyone on reasonable terms.

Regarding the international applicability of the final U.S. HDTV standard, the combined system includes many elements of the evolving international MPEG 2 standard currently being developed. Our system includes other capabilities as well, and we are working together to encourage MPEG to incorporate these capabilities in an HDTV profile within the standard.

By harmonizing the system with an internationally accepted standard, we expect that key elements of the U.S. standard will be more readily accepted by other regions of the world. We have agreed to promote the combined system as a standard throughout the world.

In summary, the members of the Alliance believe that the proposed system, if ultimately accepted by the Advisory Committee and the FCC, will maintain and enhance the U.S. leadership position in digital television technology and in HDTV in particular. We should not delay the process to evaluate any theoretically superior system for which neither hardware nor software has been implemented, nor should we stop now to study the interoperability issue even further. Such delays would serve no useful purpose but would only allow our European and Japanese competitors to narrow or eliminate the U.S. lead in HDTV technology. We must not allow this to happen but must proceed as rapidly as possible if U.S. consumers and the U.S. economy are to capitalize on this critical new technology.

Thank you.

[The prepared statement of Mr. Graves follows:]

Statement of Robert K. Graves

AT&T Vice President, Video Technology and Infrastructure

On Behalf of the HDTV Grand Alliance Proponents

Before the

Committee on Science, Space and Technology

Subcommittee on Technology, Environment and Aviation

United States House of Representatives

June 24, 1993

Statement of Robert K. Graves
AT&T Vice President, Video Technology and Infrastructure
On Behalf of the HDTV Grand Alliance Proponents
Before the Committee on Science, Space and Technology
Subcommittee on Technology, Environment and Aviation
United States House of Representatives
June 24, 1993

Good morning, Mr. Chairman and members of the Subcommittee. My name is Robert Graves and I am an AT&T Vice President responsible for video technology and infrastructure matters. I am joined today by James Carnes of the David Sarnoff Research Center and Robert Rast of General Instrument Corporation. We have all been involved for several years in the FCC's process for setting an HDTV transmission standard, and we're here to speak to you about the recently formed HDTV "Grand Alliance".

This alliance is an agreement by the remaining HDTV system proponents to join their efforts to produce a single, best-of-the-best system to propose as the standard for the nation's next generation of television technology. We want to share with you today the rationale behind the alliance and the highlights of the agreement that we have submitted to the FCC's Advisory Committee. We believe that our proposal, if accepted by the Advisory Committee and the FCC, will speed the implementation of HDTV and enable the U.S. to maintain and

enhance its worldwide lead in the development and commercialization of this vital new technology.

In 1987, the FCC began the process of defining an HDTV transmission standard for the United States. With strong support from the Congress and visionary leadership from the FCC and from former FCC Chairman Richard Wiley who has led the Commission's HDTV Advisory Committee, the U.S. has leap-frogged over earlier analog-based HDTV development efforts in Japan and Europe into a preeminent position in the development of an all-digital HDTV system. From an original field of 23 different proposals, the Advisory Committee spent 15 months testing six systems, and by February of this year had narrowed the race to four remaining all-digital systems: one offered by Zenith Electronics and AT&T, two by General Instrument and MIT, and one by North American Philips, Thomson Consumer Electronics and the David Sarnoff Research Center.

Last February, the Commission's Advisory Committee decided that while all of the digital systems provided impressive results, no winner could yet be named as the U.S. HDTV standard. The Committee ordered a round of supplementary tests to evaluate improvements that had been made to the individual systems. At the same time, the Committee encouraged an alliance among the remaining proponents, saying that if the parties could reach such an agreement, the Committee would evaluate such a combined proposal rather than

proceed with a costly and time consuming second round of testing.

There were many good reasons for this approach. It enabled us to agree upon a combined system that incorporated the best features of each system. It obviated the need for a second round of testing on the individual systems, which could have again been inconclusive. So after months of arduous negotiations, we were finally able to announce the formation of an alliance on May 24th. (The press release is attached.) We believe that this proposal can save a year or more in the implementation of HDTV, not only by avoiding the risk of ambiguous test results, but by lessening the possibility of legal or other challenges to the FCC's ultimate decision.

We believe the Alliance is good news for everyone--consumers, broadcasters, cable operators, the computer and telecommunications industries, and for U.S. workers. In structuring the proposal, we have kept uppermost in our minds the needs of these key constituencies and incorporated capabilities that are vital to each of these groups. For instance, the system incorporates progressive scan transmission and square pixels, two attributes that are extremely important to the computer industry, including AT&T, for promoting interoperability with computers and telecommunications. Likewise, needs expressed by many

broadcasters have been addressed by including interlaced scan transmission in the initial deployment.

The proposal will allow the U.S. to maintain the worldwide technological lead it has established. The rapid adoption of an all-digital HDTV system will promote the creation and maintenance of U.S. high-skilled jobs in the design and manufacture of HDTV receivers, displays, studio and transmission equipment, peripheral equipment, and programming and software development. At the heart of HDTV will be state-of-the-art integrated circuits, including advanced digital signal processors, as well as application- and algorithm-specific chips. The development and production of these semiconductors are two of the areas where the most new high-skilled jobs are likely to be created. If major elements of the U.S. standard are applied to other markets around the world, exports of U.S. semiconductors can be substantial. We estimate that in 15 years, the worldwide market for HDTV chips will be at least $2 billion annually -- with half being sold in the United States.

As for consumers, they will reap the benefits of the best technical minds collaborating to bring theater-quality pictures and sound to American homes, as well as a host of new applications in home entertainment, education, computer and medical imaging, factory automation, publication, etc.--all stimulted by the early adoption of this technology.

We want to reassure the Subcommittee that we fully understand that the HDTV standard setting process will remain a public, open process. The Advisory Committee will convene its technical subgroup beginning next week to evaluate the Grand Alliance proposal in detail. If necessary, this group will negotiate changes to the proposed system with the alliance members. In the meantime, the alliance members are finalizing the specifications of the combined system in a few areas that are not yet fully resolved. Once the Advisory Committee's technical subgroup has approved the basic concepts of the combined system, the alliance members will work together to construct the system. After that, the Advisory Committee will conduct extensive laboratory tests to ensure the system meets its expectations. If it is satisfied, the Advisory Committee could then recommend the system to the FCC and simultaneously begin field test verification of the system's performance. The FCC, in turn, would consider the Committee's recommendation in a rulemaking proceeding which we hope could be concluded by the end of 1994. Whatever standard is adopted, the FCC requires that the applicable technology be licensed to anyone on reasonable terms.

Before closing, let me say a few more words on the technical aspects of the system, especially on the very important issue of interoperability. (Additional detail is included in the attached technical description of the system.)

To promote the best possible interoperability with computers and telecommunications, the Grand Alliance partners have all committed to progressive scan transmission (where each line is scanned sequentially) and square pixels (where the dots on a television screen are arranged in equally spaced rows and columns). Furthermore, the proponents all agree that as soon as it becomes practical, a progressive scan system with more than 1000 lines and 60 frames per second would best serve the needs of everyone--including broadcasters and cable operators. In the meantime, to satisfy the near-term concerns of many broadcasters and cable operators, the alliance system incorporates one interlaced format (where first all the odd and then all the even lines are scanned). Every TV will be able to receive both the progressive and interlaced formats, and will be able to convert the format to whatever display mode exists in that particular receiver.

All of the formats will provide square pixels, and the system will utilize a prioritized, packetized data transport structure with universal headers and descriptors to promote interoperability and to provide extensibility, i.e., head-room for future growth of system capabilities.

Looking to the global marketplace, the combined system includes many elements of the evolving Moving Picture Experts Group (MPEG-2) standard currently being developed under the

auspices of the International Standards Organization. Our system includes other capabilities as well, and the proponents have agreed to work together to encourage MPEG to incorporate these capabilities in an HDTV profile within the standard. By harmonizing the system with an internationally accepted standard, we expect that key elements of the U.S. standard will be more readily accepted by other regions of the world. The alliance proponents have agreed to promote the combined system as a standard throughout the world.

In summary, we believe that this alliance, if ultimately accepted by the Advisory Committee and the FCC, will maintain and enhance the U.S. leadership position in digital television technology and in HDTV in particular. We should not delay the process to evaluate any theoretically superior system for which neither hardware nor software has been implemented, nor should we stop now to study the interoperability issue even further. Such delays would serve no useful purpose, but would only allow our European and Japanese competitors to narrow or eliminate the U.S. lead in HDTV technology. We must not allow this to happen, but must proceed as rapidly as possible if U.S. consumers and the U.S. economy are to capitalize on this critical new technology.

For all the reasons I've cited--great new TV, a plethora of new applications, interoperability, jobs, global markets, and technological leadership--the Grand Alliance is clearly

the best approach for driving the commercial and technological development of HDTV in the United States and throughout the world.

Attachment to Statement of Robert K. Graves

Technical Description of the Grand Alliance

The technology incorporated in the Grand Alliance combined system can be described in five key areas:

1. Scanning Format

The system provides multiple formats to support practical implementations during startup of the service, and yet provide a strong impetus toward the eventual exclusive use of progressive scan in order to facilitate interoperability of HDTV with computers and telecommunications.

The long-term standard will be built around a family of 1050-line progressive formats, at frame rates of 60, 30 and 24 frames per second. 60 frames per second is not practical in the near term, but as technology evolves and improves, this format will be supported with backward compatibility to existing HDTV receivers. 30 and 24 frames per second progressive formats are included in the initial system. These frame rates are used for film material.

To ensure that practical modes exist for live video, the system will provide both progressive and interlaced formats initially. 787-line progressive modes at 60, 30, and 24 frames per second will be supported. A 1050-line interlaced mode at 60 fields per second will also be supported.

All sets will be able to receive the six supported formats, and will be able to convert to the display format of the particular set, if necessary. The added cost to enable sets to receive multiple formats is not unreasonable, and will decrease over time.

All film material will be sent in progressive transmission format.

The 1050 and 787-line formats both provide square pixels.

2. Compression

The video compression technology used in the combined system incorporates key features from each of the four digital HDTV proposals. The resulting system shares many components from the ISO (International Standard Organization) MPEG-2 proposals, but it is not identical. Parties to the alliance have agreed to work with the industry and seek support for the combined system in the ISO forum as the MPEG-2 HDTV profile.

3. Transmission

Four transmission system approaches will be evaluated further before a final selection is made. The four are variations of Vestigial Sideband (VSB) and Quadrature Amplitude Modulation (QAM) approaches. Analyses based on the existing proponent systems as improved will be conducted. A competitive bakeoff may also be held, if necessary.

4. Audio

Three systems are under consideration, and subject to further evaluation: Dolby AC-3, Musicam 5.1 and MIT-AC.

5. Communications Protocol

A packetized, prioritized data transport format with universal headers and descriptors will be used to promote system flexibility and extensibility.

6/22/93

Advisory Committee on Advanced Television Service

FOR IMMEDIATE RELEASE: May 24, 1993

HDTV "Grand Alliance" Proposal
Will Be Considered by FCC Advisory Committee

Washington, D.C. The Federal Communications Commission's Advisory Committee on Advanced Television Service (established by the Commission in 1987) will review a single digital high definition television (HDTV) system proposed today by a "Grand Alliance" of entities that, until now, had sponsored the four remaining competitive HDTV systems. These entities (AT&T, the David Sarnoff Research Center, General Instrument, Massachusetts Institute of Technology (MIT), North American Philips, Thomson Consumer Electronics, and Zenith Electronics) today reached a business and technical agreement and submitted to the Committee a merged system proposal.

The proposed system, if recommended by the Advisory Committee and adopted by the FCC, could place the U.S. in the forefront of high definition video technology. An all-digital standard, which would facilitate interoperability among broadcasting, cable, computer, and telecommunications technologies, has worldwide potential.

Advisory Committee Chairman Richard E. Wiley, who had encouraged the complex negotiations leading to the agreement, said "I believe the Grand Alliance proposal, subject to Advisory Committee and ultimate FCC approval, will help to conclude a process that has fostered the development of highly advanced digital HDTV technology. The members of the Alliance should be commended for their accomplishments." Wiley added that the benefits of the Grand Alliance include development of a digital system incorporating the

best elements of the four systems and acceleration of HDTV service implementation. The FCC's Advisory Committee endorsed the Alliance concept at a meeting in February.

Important aspects of the Grand Alliance technical proposal submitted today include the employment of progressive scan transmission (where entire picture frames are transmitted sequentially) and the use of so-called "square pixels" (where the dots on a television screen are arranged in equally spaced rows and columns). Both of these design aspects are important for the interoperability of HDTV with computers, telecommunications, and other media and applications. Interlaced scan transmission (as deployed in today's TV systems) would also be accommodated in the initial deployment.[1]

Specifically, the proponents agree that all large-screen HDTV receivers (34 inches in diagonal and above) will incorporate a 60 frame per second 787.5 line or higher progressive scan display mode. Progressive display would be optional initially for smaller screen receivers. The proponents also concur that all transmission of film material will be in a progressive scan format beginning immediately upon the commencement of HDTV service. Finally, the Grand Alliance proponents unanimously endorse the objective of migrating the standard to a high line number (i.e. thousand-line plus) progressive scan transmission, as soon as feasible, and will work together to eliminate interlaced scanning format from the transmission path in the future.

To support multiple transmission formats, the merged system will feature source adaptive processing. Moreover, to promote system flexibility and extensibility, the merged system also will feature a prioritized, packetized data transport structure. Additionally, the

[1] MIT believes that a digital video broadcast standard that exclusively utilizes progressive scan transmission, from the beginning, is in the best interests of the United States.

Grand Alliance entities agree to support the Alliance's proposed HDTV compression system in the International Standards Organization as the MPEG-2 HDTV profile.

Over the next few weeks, Advisory Committee participants will review the technical merits of the Grand Alliance proposal, which includes procedures for deciding on a few remaining component designs based on the results of specific tests. Various subgroups of the Advisory Committee will work with the Grand Alliance members as their merged system concept is finalized and, eventually, will oversee the testing of the completed system. Based on the results of those tests, the Committee may recommend the system to the FCC as the basis for a high definition television standard for our country. The FCC, of course, has the ultimate authority to adopt transmission standards.

ROBERT K. GRAVES

Video Technology and Infrastructure Vice President - AT&T

Robert Graves represents AT&T before the FCC and other government agencies on technology and infrastructure matters, especially those related to video products, services and public policies. He has been heavily involved in AT&T's joint effort with Zenith Electronics to promote the Zenith/AT&T Digital Spectrum Compatible HDTV system as the U.S. standard, and now is working to win FCC approval of the combined "Grand Alliance" HDTV System proposed by AT&T, Zenith, Thomson, Philips, General Instrument and MIT. Mr. Graves serves on the Executive Committee of the Advanced Television Systems Committee and as an ex officio member of the FCC's Advisory Committee on Advanced Television Service.

Mr. Graves began his career at Bell Laboratories in 1973 where he worked on customer switching systems and data network planning. He moved to AT&T in 1978 where he has held a variety of planning and government affairs positions. He has represented AT&T before the FCC on spectrum allocation and wireless communication matters, international communications issues, network quality and reliability matters, and for more than ten years on Computer Inquiry and open Network Architecture issues.

Mr. Graves received Electrical Engineering degrees from the University of Utah in 1973 and from Stanford University in 1974, and earned an MBA "with distinction" from The Wharton School, University of Pennsylvania in 1982.

Mr. MCHALE (presiding) Good morning. Gentlemen, I'm Congressman Paul McHale. I'm a freshman Member. I walked in, and they said, "You're in charge." I obviously was not present for your earlier testimony, and so I ask for your indulgence as we go through some of the prepared questions that will flesh out the earlier testimony that you provided to the panel. I want to thank you for your comments and begin presenting to you perhaps a few of those questions.

To Mr. Liebhold and Mr. Gerovac—is that the correct pronunciation?

The written testimony of Mr. Miller, who will testify on our second panel, states that the excessive interoperability demands of some of the computer industry would mean diminished video quality for the broadcast television industry and a higher cost of receivers, leading possibly to a failure of advanced television service. Would you comment on that? How would you respond to those concerns?

Mr. LIEBHOLD. I would like to offer a counter position that I have heard from some other broadcasters that the incorporation of a staged television standard is going to force the broadcasters, or at least the broadcasters are going to be asked to invest twice in equipment: the first generation of interlaced equipment and then again at the next generation of progressive scan equipment. So it is very unclear what broadcasters' interests are being well represented. I don't think these issues are yet well understood.

The point is that the Alliance members have not yet demonstrated the cost of interoperability adequately. The image quality has not been adequately tested. During the previous round of test process, the progressive scan material suffered from inadequate source material, there was not a fair test, and this is, in fact, the reason that we went into a round of retesting which resulted in the testing of a Grand Alliance, was the need to create a fair test for progressive scan.

So until I can answer your question, I would like to see the results of the testing in the laboratory center.

One other point on cost to consumers: If the costs of equipment and televisions are shared across many industries—business equipment, medical imaging, educational, instructional machines—then the costs for all consumers will be reduced. If, however, the costs are borne only by the television industry, then the costs will be indeed higher.

Mr. MCHALE. Dr. Gerovac, would you comment on that?

Dr. GEROVAC. Along those same lines, there have been a variety of studies done that are trying to look at the cost issue, and it has to be that when advanced television services first begin sets will be very expensive, they will cost more than what a low-end personal computer costs these days. By leveraging the usage in a broader environment, you are going to be able to have some sharing of cost in the initial deployment, and I believe that in the long run you will end up deploying much more rapidly to the consumer if you can bear those costs by people who are willing to pay for it early on.

Mr. MCHALE. Yes, Dr. Carnes?

Dr. CARNES. Wouldn't that argue then that inclusion of interlace which will allow for lower cost broadcast and lower cost receivers early on, which would cause a faster growth of HDTV, would result in lower costs sooner for K-12, not higher costs, as Mr. Liebhold had suggested earlier?

So I think interlace helps the cost issue and helps the expansion of HDTV and therefore causes everybody—and I agree with this—to benefit from the technology and sooner.

Mr. MCHALE. Doctor, we appreciate your comment.

Gentlemen, as we pose these questions, feel free to make that kind of comment though the question may be directed at one or more members of the panel. We appreciate the initiative shown by Dr. Carnes in the last response.

The next question goes to all members of the panel.

Some argue that Government support of camera, coding, and display technologies has provided an adequate technology base to support initial progressive scan products on the market in a few years. Are you in a position to comment on this, and do you agree with this?

The second part of the question is, if so, do you believe that HDTV implementation should be delayed until a fully progressive scan system is available?

Why don't we just begin on the left with Mr. Liebhold and move to the right.

Mr. LIEBHOLD. I have only heard reports of excellent technology in the defense community funded by the Advanced Research and Planning Agency. I believe there is going to be some public discussion of these in the coming weeks. It is not clear yet, but there is some excellent technology.

I think the point of timing is an interesting issue. Right now, it looks like HDTV will roll out somewhere in the late '96/'97 time period. That is going to be a time period when about five other technologies are going to be hitting the power curve—video on compact discs, video telephone, direct broadcast digital satellite, digitally encoded cable television. It is going to be a fiercely competitive market for digital information systems in that time frame.

It is not clear that consumers want brighter, clearer pictures. They may go for lower resolution, broader selection of pictures in that time frame. So it is not clear that actually targeting the delivery of an HDTV by that date is going to be financially practical for anyone, and given that kind of business climate, I don't see any harm in establishing a technical standard today and then pulling all of our resources together to deliver the definitive, world class, high resolution system in time for the evolution of large high resolution displays later in the decade. We believe that when there are large displays, flat screens or cheap CRT's, even if it takes a piano mover, then consumers may be interested, but until then it is going to be too competitive to get HDTV off the ground anyway.

Mr. MCHALE. Dr. Gerovac.

Dr. GEROVAC. With respect to the first part of the question, I too have heard that there are these technologies for doing progressive scan cameras that have been developed with Federal funding and are in secret right now. I don't think we know yet what the outcome of that is going to be.

If you would like to, yourselves, try to look into that, that would be very helpful, to try to bring out some of that into the commercial sector. In the meantime, I think we are proceeding along trying to get some of that information.

In terms of the deployment of HDTV and delays and business models of what would work, I am in favor of deploying HDTV as soon as possible. I think what we have come to over the last year or so is that everyone recognizes that ultimately we want to get to a high resolution, progressive—fully progressive system, and that is one of the stated objectives in the Grand Alliance proposal.

The question comes down to what the migration path is between now and then, and that is going to require more study. I think that it is very hard to comment on what would be an appropriate thing to do without having the information in front of us right now, and a lot of this information is just coming to light.

Mr. MCHALE. Thank you.

Mr. Rast.

Mr. RAST. Thank you.

With respect to Government support in the area of cameras, independent of such support, which is good at the R&D level, those cameras are not available commercially to broadcasters. A broadcaster can't go out and buy a progressive camera. That limitation has affected what is happening right now in terms of our standardization because we have some difficulty trying to force a broadcaster into an area that he can't get commercial product.

With respect to whether the standard should be delayed, I would like to point out that the standard we are discussing applies to broadcasting, and it only—only broadcasters need a Government sanctioned standard because they use the public airways, and to decide that we wouldn't allow broadcasters to have an HDTV standard would be to deny them the ability to compete with other media, all of which could implement HDTV at any time they wanted. So it would appear to potentially penalize broadcasters and not allow the marketplace phenomena to work.

Thank you.

Mr. MCHALE. Dr. Carnes.

Dr. CARNES. Thank you.

With respect to progressive transmission, it is not only camera technology which—clearly progressive cameras are more expensive and not available commercially, as Mr. Rast pointed out, but it is also a matter of the capability to compress. If we are going to do 1,000-plus line systems, we cannot—we don't know how to compress that much information and put it in a six-megahertz channel today; we just don't know how to do that. So even if there were progressive cameras that could do 1,000 lines, we can't squeeze it through the hole.

I think timing is of the essence. We have a lead. We know that Europe is very active in digital. Those who were in Europe last week or a couple of weeks ago at the Montreux TV symposium realize there is much, much work in digital going on there. In Japan, there is not as much work being announced, but it is a lot of work, we know, sub rosa in Japan, and they are working very diligently to come up with digital standards. if we delay here in the United States, we are going to give up our lead, we are going to delay the

benefits that were so eloquently talked about of HDTV to the medical, to the educational, to the business competitive communities. Let's get on with it. We know how to do it. Let's get on with it.

Mr. GRAVES. I would like to reiterate the fact that the centerpiece of our Grand Alliance proposal is progressive scan, and when it is technically feasible it will be 60 frames per second, greater than 1,000 lines progressive scan. That is the goal that we are working toward, and every part of the solution that we have crafted is built toward doing that, and we are looking for ways to hasten the transition to that approach, and we welcome input from all quarters in helping us do that, and we hope that through our deliberations with the technical subgroup of the Advisory Committee that we will be able to flesh that out even more.

I think it is important to point out that I and my firm have been an ardent supporter of progressive scan. There are no more ardent supporters of progressive scan than at AT&T and also MIT, another member of the Grand Alliance, but we reached an agreement that the way to move forward in light of the realities that we face—a lack of progressive scan camera equipment at the present time and also an inability to carry that 60-frame-per-second, 1,000-line progressive system through a six-megahertz broadcast channel—that this is the best approach to support six formats, and, contrary to what you have heard at least once here this morning, we believe supporting those six multiple formats can be done at relatively small additional cost.

We should point out that it is our recommendation to the Advisory Committee that all film material be carried in progressive from day one, and we are exploring ways to extend that to—possibly to other sorts of material. But as many of you may know, most of the prime time programming that is produced for television is produced in the film medium, so it is not just movies but the bulk of the material that is carried over TV would be carried progressively from day one.

Now there may well be a role for Government to help in spurring the introduction of progressive scan camera technology and display technology, and we certainly would welcome that. I would just mention that, along with Xerox and Standish Industries, AT&T has made a proposal for a joint Government-industry initiative in the area of flat panel displays, and I would extend an offer to my colleagues in the computer industry that any help they can provide in funding the development of progressive camera technology would be greatly appreciated.

I think the most important thing is to state that as our goal, and, having done that, it will give us the ability to begin to develop the progressive scan camera technology, and I think, more than anything else, the most important thing for us to do is to move forward as quickly as possible to implement the standard.

Mr. MCHALE. Gentlemen, I thank you for your responses. I am going to move now to my colleagues on the committee to inquire as to what questions they might have.

I apologize once again that, because of another commitment, I was unable to attend your initial testimony, but I thank you very much for the responses that you have given to the questions that I have presented to you, first of all because it will assist me in ad-

dressing this issue and, secondly, because my wife has worked for many years as a television producer and editor, and, thanks to your expertise, I will dazzle her tonight.

I now turn to my colleague, Mr. Zimmer from New Jersey.

Mr. ZIMMER. Thank you, Mr. Chairman.

I would need more than that to dazzle my wife.

I would like to ask Mr. Liebhold and Mr. Gerovac whether it is an oversimplification to say their position is simply to ban interlace from the proposed standard, to simply say you may not incorporate interlace technology.

Mr. LIEBHOLD. I don't think it is an oversimplification. I think it is a very reasonable point, because once interlace is incorporated, many, many industries will become captive to that technology and, in fact, will be compelled to make onerous multiple investments. By starting at progressive only, we will have an incremental evolution into the future to higher performance systems.

Mr. ZIMMER. So it was not an oversimplification. Okay.

Then if progressive scanning is so attractive and has all the benefits that you have proposed for it, why won't the private sector support it either now or after the interlace technology is in the field?

Mr. LIEBHOLD. Could you restate the question?

Mr. ZIMMER. All right. Your concern is that we are headed off into, if not a dead end, a period of delayed progress because of the economic investment that would be made by the industry interlace technology, and my question is, if the progressive scan technology is so obviously superior, why won't the private sector support it anyway?

Mr. LIEBHOLD. Well, a couple of points. One, billions of dollars have already been invested in interlace technology in Japan and in Europe, and they would be significant beneficiaries of an interim interlace standard, billions of dollars.

I would also say that billions of dollars have been invested in progressive display in this country. All computer imaging systems are progressive scan; all film is progressive scan. So it would allow us to continue our investment and share the benefits of our investment with a much broader mass market community.

Mr. ZIMMER. Then if you are that far off the dime in developing progressive scan, why do you want to ban interlace? Why is it such a threat?

Mr. LIEBHOLD. The early introduction of an interlace standard would mean that both the production community and the end user community are going to be captive to the installed base. There would be a de facto state.

Mr. ZIMMER. I would like to know whether anyone else on the panel has a view on the captive theory.

Dr. GEROVAC. Let me provide a slightly modified perspective. I think what we are really after is to not disadvantage progressive scan as we move forward with advanced television service. Now, if there is a way to not do that yet provide a migration path, then we might be willing to do that. So far, we haven't heard that.

You know, the Grand Alliance technical description is brand new. It doesn't go into a lot of depth. Someone earlier said that we need to go into the details at this point. So some of these questions are

hard to answer. Can there be an accommodation for interlace and progressive scan that doesn't disadvantage moving into the future, doesn't disadvantage an actual information restructure? There may be. We haven't looked at those details. Hopefully over the next month or two, we may be able to. And I recognize that people within the Grand Alliance who have more in-depth knowledge of what their current discussions are and what their current technical specification is believe that they have addressed that. I think we are just asking for the collaboration to continue and for other people to evaluate what they have done.

Mr. ZIMMER. So you are not saying it is inevitable that there will be a delay in the adoption of the progressive scan technology. You think that it is at least possible that there is a feasible migration path from the one technology to the other.

Dr. GEROVAC. I hear that there is a migration path, and I am very open to listening to it and responding to it.

Mr. ZIMMER. I would like to know whether the Grand Alliance witnesses have some specifics.

Yes, Dr. Carnes.

Dr. CARNES. I just want to comment on the statement that Mr. Liebhold made that Europeans and Japanese interests would profit greatly if there were an interlaced standard. In fact, whether we have an interlaced standard or whether we have a progressive standard, equipment is going to be made wherever it is going to be made. There is nothing inherent about progressive versus interlaced that keeps Japan or Europe from making progressive or helps them make interlaced. That is not true. The fact is, most cameras are going to come from—broadcast cameras are going to come from either Japan or Europe no matter what the standard is because that is where the industries are. It has nothing to do—it is not like we have some secret formula here and we know how to make progressive cameras and the Japanese and Europeans don't. Everybody has more difficulty making a progressive camera. They are more expensive, they are more difficult to make, because the requirements are higher on the speed of scan. So I believe that is a specious argument.

Mr. RAST. And I would like to comment. I thought your questions were exactly on the mark that if there is an inherent advantage in progressive, that advantage ought to be apparent to buyers and developers, and that advantage ought to show up in the marketplace.

I don't think we can force it. In fact, we have a risk—first of all, we would like it to be true, because if it is true we think there is an advantage for the United States, but we can't insist that it is true, and if we do insist, and if we are wrong, then the United States will be at a disadvantage in the rest of the world, but we would love to export this technology. We are leaders in the world right now in this technology. We want to be careful that we not get too far away from our marketplace.

Mr. GRAVES. If I might answer from the perspective of someone who has been trying to convince the Advisory Committee that progressive was the way to go, many broadcasters—not all broadcasters but many broadcasters have come to the conclusion that they need to have more than 1,000 lines, and others of us have felt

that 787 lines progressive is equivalent to 1,050 lines progressive, but I must confess that we have not been able to convince many broadcasters. We have convinced some but not all. And broadcasters are the primary market for this standard. It is broadcasters that have to accept this as a standard, and, of course, ultimately the American public in the market have to address this.

We have gotten universal agreement, I would say, that when we can get to 1,000 lines progressive, everyone believes that is the right way to go, and, as I said before, that is the centerpiece of the standard.

So we think that we have struck the proper balance by looking at this multiple format system where we have six formats that every receiver will support at reasonable additional cost. Five of those formats are progressive; much material will be in 1,000 lines progressive in the—at the lower frame rates, and so we think this is the proper balance to move the industry forward quickly. As I have said before, I think the most important thing is that we move on quickly, and if progressive is superior, as many of us believe it is, we believe the marketplace will bear that out.

Mr. ZIMMER. I would like to ask one final question addressed initially to the first two panelists. The computer industry has been criticized for not putting its money where its mouth is in this debate, insisting on interoperability and insisting on an exclusively progressive scan system, but you represent or you work for two very large corporate enterprises who are entirely capable of producing products for the consumer based on the progressive scan technology. Will you do so? Are you going to put your money into that kind of production?

Mr. LIEBHOLD. The answer is yes. In fact, we have been in the consumer electronics business since the late 1970's. The Apple II was essentially consumer product, and we made many, many billions of dollars. In fact, it was a multi-media product.

Mr. ZIMMER. Just millions?

Mr. LIEBHOLD. Billions.

We sell a great deal of products through the consumer channel, and so, you know, we have—and I believe that some of our other colleagues in the computer industry have long standing presence in the consumer electronics industry as well.

We have made a standing offer to organize computer industry contribution to the advisory process. So far, we haven't had the technical opportunity to do that. We expect to do that. We expect to participate heavily in the support of the test center in Alexandria to ensure that the kind of tactical testing is employed to validate many of the claims that we are hearing today and have heard off line.

Mr. ZIMMER. I am not talking about putting your money into the testing, I am talking about putting your money into the development of products that will use the technology that you are so enthusiastic about.

Mr. LIEBHOLD. The answer is yes, we are indeed investing in these technologies.

Mr. ZIMMER. Thank you.

Dr. Gerovac.

Dr. GEROVAC. Speaking for myself, if we believe in the interoperability and the importance of a national information infrastructure, clearly computer companies are going to be significant players in providing information both in channeling the information and in sourcing the information and in presenting the information to the individual. That clearly has to be where the industry goes and participates in the information infrastructure.

We have been selling displays not—we don't sell quite as many displays as the television industry does, but it is within a small multiple, and all of those displays are progressively scanned. The computer industry started 10, 15 years ago to produce its initial displays with an interlaced scan format, and that proved to be inadequate, and we moved very rapidly to the progressive format, and that was driven by market forces. Now whether those same market forces will come to bear now is unclear, but we do have the historical perspective on it.

Mr. ZIMMER. Yes, Mr. Carnes.

Dr. CARNES. I just feel compelled to comment about some of Mr. Liebhold's comments about the Advisory Committee process and about whether it is open and whether there has been participation in it. I think his indictment of the Advisory Committee process is both factually inaccurate and it is unfair.

We, the proponents, have been working with the committee for about six years, and we have had some differences with the Advisory Committee, but the committee has always operated openly, with everybody free to participate, and the composition of the committee is not dominated by equipment—TV equipment manufacturers. In fact, they might be under-represented. The committee has had broad representation from broadcast, cable, production equipment communities, as well as equipment manufacturers, and the computer industry. Indeed, Mr. Liebhold himself has served on one of the technical subcommittees of the Advisory Committee.

Mr. Liebhold's problem is more fundamental. The FCC process is mandated to develop a terrestrial broadcast standard, not a computer standard. Mr. Liebhold would have Congress simply junk the enormous progress that has been made to date, including the technological leap to digital television within the context of the FCC process, and now shift to a computer standard, ignoring the needs of TV viewers and the needs of broadcasters. Mr. Liebhold is rejecting a technological compromise which gives American consumers real choices and, instead, is asking the Government to force upon consumers a technological limitation which serves the narrow economic interests of the computer industry. Congress should not succumb to that special interest plea.

Thank you.

Mr. ZIMMER. Mr. Liebhold, I guess you get a rebuttal, and then we will have to vote.

Mr. LIEBHOLD. I have to respond since that was directed at me personally.

The issue is that the communities that are going to be impacted are not represented. I am not talking about computer industry, I am talking about the users of communications and media products—schools, doctors, business communicators, technical architects, and people in the defense image community. There is no rep-

resentation, there has been no representation, there are no mechanisms for representation of these communities, and that was, in fact, what stimulated the creation of the High Resolution Advisory Committee in the Office of Science and Technology Policy.

We are not saying scrap the FCC process. Let the FCC process go ahead; it is a good process. There has been a lot of technical diligence, and although I may not agree with some of the conclusions, the process to date has indeed been open.

However, now all of the technical decisions will be made privately by the proponents themselves and be delivered, fait accompli, to an advisory committee. This clearly delineates a public interest and a private interest. It is important now that we institute a second, parallel process to ensure that the stakeholders of high resolution imaging have an opportunity to view the FCC standard in its context for a broader range of uses beyond broadcast.

Mr. GRAVES. It is simply not true that the Grand Alliance proposal will be delivered as a fait accompli. My written testimony gives extensive detail here of the process we expect will go forward. We are making a proposal to the Advisory Committee, initially to a technical subgroup of that Advisory Committee. If they love it, we will be happy. If they force us to change it, we will have to negotiate modifications to make them love it, and then they will propose it eventually to the full Blue Ribbon Advisory Committee. If they don't love it, they will demand changes. Only after they love it will they recommend it to the FCC, and then the FCC will have a full, public, open process that will take too many months from our perspective, even though they will do it as quickly as they can. All that has to take place before this standard will ever be set. So it certainly is not a fait accompli. We certainly do not think of it as a fait accompli by any means.

Mr. ZIMMER. Thank you, gentlemen.

Mr. SWETT (presiding). Thank you, Mr. Zimmer.

I think what we will do is, I will ask a couple of questions for the next three or four minutes, and then we will conclude for the Members to go vote. Hopefully at that time Mr. McHale will have returned and we can continue the hearing without any interruption to you gentlemen. We appreciate the testimony that you have been giving so far. I find this a very fascinating, somewhat confusing subject and look forward to hearing more as the day goes on.

I want to follow up on what we were just discussing. Mr. Liebhold, you were talking about the need to bring in the user groups that will require the higher resolution—the higher quality progressive technology. Have these groups been contacted? Are they on board? Are they contributing to this development process? How do you propose that to take place?

Mr. LIEBHOLD. No. There has been industry participation from the communications industry, from the computer industry. It has been well documented that a number from industries have been involved. But it is apparent that as the standard goes forward there is going to be a considerable economic impact. The costs of interoperability are not going to be borne by the broadcasters or by the Grand Alliance, they are going to be passed along to these other

communities. I think these other communities should at this point, this historic juncture, have to understand the impact.

Mr. SWETT. Well, how is that going to be accomplished? How are those costs going to be passed on? How are they going to be brought in to participate in the development?

Mr. LIEBHOLD. Well, this committee stimulated the creation of a second panel, High Resolution Advisory Panel, and to save time in the establishment of an American standard we should have a parallel process rather than sequential process so that as the technical standard is developed we have a thorough and detailed review with the stakeholder communities on the impact of this process on their communities, and that could be handled out of OSTP, or, if the FCC would choose to advise—or to form an independent advisory process free of commercial interests, including computer interests, to develop an independent opinion, I think that would be quite satisfactory as well. The FCC is perfectly capable of setting up a separate, independent advisory process.

Mr. SWETT. When you mention parallel versus sequential, are you talking about parallel interlace and progressive simultaneously?

Mr. LIEBHOLD. No, no. I am talking about two concurrent processes of evaluating the impact of advanced television.

Mr. SWETT. Okay.

Mr. LIEBHOLD. One through the auspices of the existing Advisory Committee, which is essentially a technical and business advisory, from the—the equipment industries—and I refer to to equipment as much broader than television equipment. All equipment companies are active in this. I am talking about a community that could be, in fact, part of the National Information Infrastructure Council that Vice President Gore is chairing, could be part of the High Resolution Advisory Council, could be a separate, independent process in the FCC.

Mr. SWETT. Dr. Carnes, you seem to have a comment you would like to make.

Dr. CARNES. I take great variance with what Mr. Liebhold said. I think to set a standard free of any commercial interests just does not make any sense, and to bring the user community, the K-12 community in, I am not sure, free of commercial interest, how you do that. Do we bring in some schoolchildren and ask them if they want progressive or interlace?

As far as we are concerned, we have clients. We represent certain constituencies, and we know what they need. At Sarnoff, we have long been involved in consumer electronics, and we think we know a lot about the kind of things that appeal to the consumer. We also are involved with educational testing service, Mitre, the Advanced Research Projects Agency, and Department of Defense in a consortium to put technology into the classroom. We think we understand what is needed in the classroom, and I suggest that Mr. Liebhold make sure that he understand what his clients need and properly represent those needs in this ongoing standard setting process. We don't need two parallel standard setting processes. That's oxymoronic.

Mr. SWETT. Mr. Graves.

Mr. GRAVES. I think it would be disastrous to implement a second parallel process, and it is totally unnecessary. Mr. Miller will speak to you in a few minutes, and he spends all of his—a great deal of his time worrying about educational applications. There are many, many people involved in the Advisory Committee who have a great deal of expertise in various of these applications, and the process is open to anyone else who has an interest and feels that that interest is not being met to have it reflected.

Ultimately, if this does not succeed in the marketplace, we all fail together. We are very mindful of that in everything that we do. To win a decision on a standard and think that we won something and have it be rejected by the ultimate users of the service would just be foolhardy. So I believe we all have that, not just the proponents, but everyone in the Advisory Committee has that in the back of his or her mind as fundamental groundwork for everything that we are doing, and anyone who thinks that isn't being adequately captured has the opportunity to bring that expertise to bear in the Advisory Committee process.

Mr. SWETT. I appreciate your responses.

I am going to have to go vote. I have four minutes. I appreciate your patience in the way that we conduct business here. I am going to recess this hearing for approximately 10 minutes while we conclude our business on the Floor. Hopefully, we will be able to commence shortly thereafter.

Thank you.

[Recess.]

Ms. ESHOO (presiding). I think we will resume the hearing, and I would like to thank my colleagues for stepping in for me while I went off to testify. We will wait for the gentlemen to take the table, and I would like to call on my distinguished colleague from California, Mr. Rohrabacher, for questions that he may like to ask of the panel.

You need to turn your microphone on so we can hear your wonderful question better.

Mr. ROHRABACHER. Well, my beeper just told me that a decision by the Base Closure Commission may have just been made on a military facility in my district, so that—isn't that interesting?

I would like to thank you all for coming today. I thought this has been a fascinating hearing for a novice like myself, and I barely know how to turn on my videotape machine, and I certainly don't know how to program it yet so it records exactly what I want it to record, but I know it can do those things, and I'm always amazed when people come to Government looking for wisdom when we have such minimal technology—technological understanding.

I first came here in 1989, I was elected in '88, and a big issue at that time was HDTV and what role we were going to play in it, and I seem to remember that there was a lot of pressure from different interest groups for us to put I think about $600 million into developing HDTV in order to compete with the Japanese, but, had we done so, there was a good chance, in looking back, that that money might have gone into analog HDTV which would have been already outmoded.

I mean that is just my memory of it, and it sort of reconfirmed for me that sometimes when we expect Government to make the

final decisions that there is a good chance that Government will make the wrong final decision and waste a lot of money, and, from what I am hearing today, perhaps the industry is looking to Government to make another final decision.

I am not sure if that is what we are getting at here, but I seem to hear coming from this gentleman from Apple Computer here, Mr. Liebhold, that if we pass a standard that will set a standard that is higher than what we have got available today, meaning technology that is more advanced than what we have exactly available today but is in line, it's coming down the road in our direction, that it will save billions of dollars of retooling in the future, and that if we focus also, with this standard, if we focus on this technology that is basically a progressive technology, that this is an area that America has a demonstrable advantage, and we also—if I can summarize, what you are saying also is that interim standards tend to last a long time and could actually impede America's progress towards what eventually will be and is admitted by most people who know—and I am not one of them, because I don't know—to be in a superior system, and I believe that is the arguments that you are presenting to us today.

On the other hand—and I might say that I certainly admire someone who can come forward and sit in a panel with four people who obviously disagree with him, and on the other side we have people who are suggesting that we can actually make the system better right now, and we have put a lot of money and investment into trying to move forward on this and that the industry is ready to move forward, and why should we wait for the perfect—and if this is not the summary, let me know if I am wrong here—why should we wait for the perfect when something that we can do to make the system better right now is available, and that you are actually denying—that actually setting up an interim system that has the best of both worlds will in any way impede an evolution towards the progressive system. Is that correct? Am I understanding what you are telling me? Go right ahead.

Dr. CARNES. Except we don't propose an interim system, we propose that we transition in the future to full 1,000-line progressive, but that the standard is not an interim standard, the standard basically will go forward.

Mr. ROHRABACHER. Go right ahead.

Mr. GRAVES. If I may add to that, one of the beauties of an all-digital technology is the flexibility that it gives us, and much of the—there are tremendous capabilities built into the system using a system of headers and descriptors. If you just imagine a bunch of bits hitting you in the face, or hitting the TV receiver, at the beginning there are some bits that tell you what the bits to follow are. It gives you incredible flexibility. We use a fancy term for it called extensibility, which really means the kind of head room. That means this standard can last us for decades to come. We are building in the hooks from day one so that when we build greater technical capabilities in the system, today's receivers will be able to code the bits that make sense to that receiver and ignore bits that make sense to more advanced receivers down the road, but that will allow us to send to the market more advanced TV sets

later without making obsolete the sets that are still there. So there are tremendous capabilities.

All this talk about interoperability—and it is very important, but the fact that this is an all-digital system gets us 90 percent of the way towards the interoperability that we want, and to get the other 10 percent, which is very important, we need square pixels and progressive scan, and we think we have struck the right balance to get as far as we can towards that now and chart that as our ultimate goal.

Mr. ROHRABACHER. Well, I'm going to admit to you that I don't know the exact meaning of some of the terms you used, but I know that there's a point to be made in rebuttal to that, and I would like to hear that, and then we could hear the other gentlemen. Why don't you go first.

Dr. GEROVAC. I wanted to help Mike out a little here.

Mr. ROHRABACHER. Okay.

Dr. GEROVAC. In the hearings as far back as '88, there were a list of criteria that were coming out of the academic computer communications industries and also out of some of the television industry people at the time, and this list of criteria has been debated for a long time. I list them in my testimony. They are described extensively in the interoperability report of the Advisory Committee.

Now, these list of criteria are things like being digital, having a packetized data structure, transmitting data the way a computer network transmits data, identifying the data you are transmitting so that you can transmit different kinds of data, and there's a list of—depending upon how you list it, eight, 12 items that are on that list—that define what interoperability is.

The Grand Alliance has done a good job of accommodating all of those, except there is still this little question about progressive scan. Now, we wonder when we see that, that, oh, okay, we now have everything, except there is this little twist right here, and what we are trying to do is, we are trying to look at that and say, "Is the little twist that they have done on this interoperability list—does it serve everyone's interest?" and that is not an easy question to answer.

We haven't had an opportunity to review all the material in the kind of depth that we would like in order to do that. We are hoping that that is going to occur over the next few weeks, few months, and I'm sure we will have a better answer for you after that period of time, but one of the things that has become clear over the last few months is that everyone is now agreeing as to what the ultimate objective is, and the question is all on how we get from where we are now, where we don't have an advanced television system, where we don't have digital television, where we don't have a national information infrastructure, and how we get from there to having this interoperable national information infrastructure that includes digital television as being a significant component.

So I think we are more in agreement than we are in disagreement, and it is the areas that we are in disagreement which are always interesting.

Mr. ROHRABACHER. We understand that in Congress because just the other day we were talking about, we don't discuss the areas where we agree because we understand there's a lot of things that

we all, as Republicans and Democrats, agree upon, and we agree in democracy, and we believe in individual freedom and human rights and things like that. So we don't talk a lot about that, and people might get a wrong impression about the United States if they just see what we are talking about and say, "Oh, they really disagree on everything." Well, actually, we disagree on about that much (indicating) where we agree on that much (indicating).

So you wanted to—

Mr. LIEBHOLD. Yes, I think that is really a correct characterization. I think, you know, what we haven't discussed is our great admiration for the Grand Alliance for incorporating the 90 percent of the technical features that are going to be genuinely useful to the country and to the world. However, the details and the points where we disagree are really critical, and it is possible that by incorporating the 10 percent of the compromise that they are talking about right here, we could be stuck for a long time with some very thorny technical issues that are going to add costs to a lot of communities.

If we start from the beginning with a television system that has a progressive display and has square pixels—and, by the way, even though square pixels, which are the little tiny dots on the screen, square ones have been identified as a critical element, as opposed to rectangular dots which add processing costs to all devices, have been agreed upon by all parties as the right thing, we are seeing now the first technical indications that, in private, the Grand Alliance is already going to compromise on that and add additional costs on incorporating nonsquare pixels. So it is a detail, technical issue, but it just points to some of the things I am saying here.

If we start with a system that really is designed for useful functionality across factors, across communities, we are going to allow a whole new suite of industries to be born in this country. We are seeing now a combination of televisions, computers, and telephones. We will see whole families of new devices that are not televisions, computers, or telephones any more. They are going to be hand-held devices with video displays, communicators with pictures, so that there could be a renaissance of American industry based on a really truly flexible architecture of standards for the national information infrastructure.

Mr. ROHRABACHER. Well, these gentlemen don't disagree with that. They are just saying that by coming up with something that they can move forward with now, it will not impede the advancement to that next step.

Is that correct?

Mr. LIEBHOLD. Well, let me say, we may have differences of opinion on that, but I think that that absolutely must be demonstrated, so as the process goes forward both the Grand Alliance and the advisory process and processes—multiple processes if necessary—are going to have to be held accountable to demonstrate the validity of either assertion, and I think it is very, very important that we get a clear fix on the cost interoperability and the cost of potential interim standards.

Mr. ROHRABACHER. Well, you know, I remember this, and may be just off the wall, a comparison, the fight between VHS and Beta, and I don't think it necessarily would have been a good idea for

Government to step in and make the decision there as to what direction they should go. I mean I don't know—it can be argued that it might have saved people billions of dollars, but it might also have been argued that maybe we might not have chosen the right system that would have presented the right avenue for the country to move ahead.

From what I have heard out of this hearing, the one thing I can—for sure that we can do: If there is a camera that we have developed for intelligence purposes or military purposes that is a progressive camera that can help our private industry now that the Cold War is over, I will do my utmost to see that that camera and that information gets out to our industry, and I'm sure everyone on this committee will agree with that. So if there is anything this hearing has brought out, we can at least do that, and I can say I will try, and I will talk to other members of the Committee to make sure that we move forward on that little piece of information that may help you.

In terms of making the ultimate decision, I would tend to think that the private sector should be permitted to move in the direction the private sector would like to go, and even though it might be argued right now that, while billions of dollars would be expended that don't need to be expended if we make exactly the right decision, aren't we also aware that new information may change that? Just like you said, there has already been a little bit of a change in the standard by whether it is the square standard or add a few dots there.

I don't know if I am making any sense. I am really out of my field.

Mr. LIEBHOLD. The other thing you could do is ensure that very bright, clear light is shone on the process so that the important issues are fully exercised in public.

Mr. ROHRABACHER. Well, I hope we have shed some light on it today, and I appreciate that very much, Madam Chairman.

Ms. ESHOO. I would like to call on—do you have anything?

Mr. GRAMS. I came in late, so I am just trying to catch up. Thank you.

Ms. ESHOO. All right. It's fascinating. We are going to have more on this.

Yes, my distinguished colleague from New Jersey, Mr. Klein.

Mr. KLEIN. Thank you, Madam Chairman.

Ms. ESHOO. We talk so nicely to one another here, don't we? Everyone is distinguished.

Mr. KLEIN. Everybody is distinguished, including the witnesses, and I want to take the opportunity to welcome the two distinguished witnesses from my home State, Dr. Carnes from the David Sarnoff Research Center, and Mr. Graves from the Video Technology Center in AT&T Labs in Basking Ridge.

I start off with a confession. The confession is that the technology and the issues, the technological issues, which you have been discussing with such articulation and sophistication are way over my head. What is very much within my knowledge and understanding and very much within my ambit of interest, however, is what the potential is for these respective technologies in terms of generating new jobs for not only the people of the country, the United States

as a whole, but also and very specifically for New Jersey, and I would first ask the two witnesses from New Jersey if they would like to comment on that, if they could.

Mr. GRAVES. Yes. Thank you.

We think the potential here is tremendous. I see two major technological fields developing at the same time, just mushrooming in terms of opportunities. One is wireless communications; the other is video communications, multi-media communications, which is a fancy word which means something different to everyone who uses it, but when I use it I mean applications that use video and data and voice together. I think of sitting at a personal computer and one of my children doing a report, putting together a report, which in the future, instead of just looking up encyclopedia articles, he or she might be able to find little video clips that could be inserted, and some day this report will be handed in on a computer disc or, even more likely, transmitted to the teacher electronically, and the teacher will sit down at a PC or maybe a television set and watch the report that the student prepared, and AT&T, especially through Bell Laboratories, as well as many other high-tech companies in New Jersey I think have a tremendous opportunity to participate in that market, this plethora of applications.

We have invested tens of millions of dollars ourselves. We believe in this market enough to have done that. We are very anxious to get on with it. We have at times been better able to invent new technology than to capitalize on it. We are doing our best to improve in that area so that we can make marketplace successes out of some of the tremendous technology that we have developed, and we have an opportunity to do that here. That is why my testimony has focused so much on getting on with this process, and, quite frankly, that was the motivation behind AT&T's desire to conclude this Grand Alliance. Our greatest fear was that we would go through a second round of testing and reach an inconclusive result, at which point the only thing to do would have been to look for a combination of capabilities. If that is the case, why not do it in 1993 rather than 1994, and get one year closer to bringing this dazzling technology to the public where it can bring these applications?

So, yes, it is a great opportunity for the United States. We have a lead, and many of the companies involved are located in New Jersey. So it is a great opportunity. We hope to capitalize on it.

Mr. KLEIN. Well, Mr. Graves, I commend you, and I commend the company for its leadership in the technology, but I would like to just focus for a moment on the point you raised about the fact that so often in the past in the computer, the TV, and electronics industries generally we in the United States have done a marvelous job of being the leaders in the technology, and we end up having so many of the manufacturing jobs—indeed, in some industries all of the manufacturing jobs—overseas, and when we look at the sorry state of American manufacturing employment, that is indeed a tremendous concern, I think one of the biggest issues we face as a nation.

What do we do to ensure that our technology not only is capitalized on by the companies but that the companies do their manufacturing here in the United States?

Mr. GRAVES. Well, I think that the best—ultimately the best insurance of success in creating jobs for Americans obviously is to have the best product and have the best product sooner. This will be an open standard. There will be tremendous competition. I have no doubt that Japanese and European companies will do well. We hope to do well and be able to compete effectively also.

I think there may be a bit of advantage inherent in the process here, as Dr. Carnes discussed earlier. HDTV sets will be large sets, by and large, and all this debate we are having about different attributes of the system is not going to affect where those sets are made. The fact that they are large and that they have a lot of glass is going to bias the decision towards making them where they—close to where they are going to be used.

I think the real advantage for us is to get to market soon with the best product, and I mentioned in my statement—and it is in more detail in my written testimony—about the efforts we are making to promote the standard as an international standard so that we might be able to export the chips and other components that lie at the heart of HDTV.

I also mentioned a whole series of related industries in production equipment and transmission equipment that will be possible, and our hope is that by competing with the best product soon in the market we will fare well in a competitive environment.

Mr. KLEIN. Dr. Carnes, did you want to comment on that?

Dr. CARNES. Yes. Thank you.

I think with Mr. Graves, of course. Many jobs will be created for the United States. HDTV sets are large, probably will be built in the United States. Two members of the Grand Alliance who are two leading TV manufacturers in the United States have pledged to make their HDTV sets in the United States.

Mr. KLEIN. Which two are these?

Mr. CARNES. Thompson Consumer Electronics and North American Phillips, the two—number one and number two producer of TV sets in the United States.

But I think the biggest impact on jobs and productivity is going to come from the use of the technology in a lot of different areas, not so much just the manufacture of TV sets but, rather, the application of the technology to reducing medical costs, for example, the use of the technology in the educational area in solving some of our education problems, and I think one of the biggest impacts will be in business communications where video-teleconferencing really has not been a big factor in our lives yet, but with HDTV digital video and the information infrastructure we will be able to communicate much, much more efficiently and much easier in a very compelling way when this technology takes hold, and so I think that impact will have such a positive impact on our productivity that it will create jobs because we will become more productive as a nation.

In New Jersey, I think we are in a position to be leaders in HDTV because we have technology infrastructure there, because of Video Valley and the existence of outfits like Sarnoff and AT&T, and I think the State government is also very interested in taking advantage of this position. Barbara McConnell, who is the New

Jersey secretary of commerce, is working on an HDTV initiative to take advantage of our leading position in this technology.

Mr. KLEIN. Just one question, and then I see Mr. Rast would like to comment. But of the total TV market in the United States, how much of it is produced in the United States?

Dr. CARNES. Over half.

Mr. KLEIN. Mr. Rast.

Mr. RAST. Yes. I would like to point out, I think there is a primary issue in front of us and a secondary issue, and the primary issue is that digital television technology is breaking on us. It was pioneered in the United States. It is making obsolete other analog technologies that have been tried in Japan and in Europe. We would like the opportunity to commercialize that and to, you know, go after the opportunities worldwide. The standard setting process is in the way right now of our ability to do that.

So the primary issue is, should we go pursue digital HDTV television technology? For the benefit of the Members from California, I would like to point out that that technology was pioneered at General Instrument in San Diego, so we were the ones who introduced it, and we are very pleased that things are going well in New Jersey, but we want to put in a plug for California as well.

Ms. ESHOO. Thank you.

Mr. RAST. The secondary issue—

Mr. KLEIN. Since we have General Instrument also located in New Jersey—

Mr. RAST. Absolutely.

Mr. KLEIN. —we would like you to bring some of that business over our way.

Mr. RAST. The secondary issue is whether it should be interlaced scanning or progressive scanning, and it is important that we realize this, the secondary issue, and we are having this discussion about whether we should wait on deploying digital technology to bring along progressive technology. I think it is important that the rest of the world does not yet see what we think we see, which is that progressive has a big future and it is an important part of the convergence of entertainment television and computers.

So, yes, it is a very good idea for us to pursue, but we want to be careful not to pursue it in such a way that it precludes our ability to wage economic war around the world with our digital technology.

Thank you.

Mr. KLEIN. Thank you.

Mr. Liebhold.

Mr. LIEBHOLD. Yes. I would like to point out that Apple Computer has some 3,000 independent hardware and software developers building products compatible with our system, and if you add another I don't know how many thousand that are building them for PC compatibles, there is an enormous American industry of entrepreneurs building a variety of hardware and software, entertainment, and business productivity, and technical products and services that could benefit from this system.

So I think that we have to ensure that jobs are created in all districts, congressional districts, in this country. I would like to acknowledge the leadership in certain high-tech communities in New

Jersey, and California, and Texas, and other places, but actually—Massachusetts—but actually there is innovation all over America, in garages and in cottage industries and big companies that create new imaging products, new communications products, new tools for doing accounting better, all of which are going to be able to operate fluidly with each other and exchange data.

The numeric data from the medical industry or the medical images can be used in a textbook; numeric data from one industry can be used in a publishing product; a publishing product should be able to be displayed on a TV; a television image should be able to be displayed on a hand-held device or a set-top device. The fluid interoperability is what is really going to give the vitality to Americans' jobs and industry in the coming decade, and so we have to all focus on that, and every chance we get to stimulate a technical process that results in maximum interoperability is going to benefit the technical entrepreneurs all over the country, I think we will have done our job.

Mr. KLEIN. Thank you very much.

Ms. ESHOO. Thank you. I think that was very well stated.

Mr. ROHRABACHER. Madam Chairman, could I ask one more question?

Ms. ESHOO. Yes, and then we need to—we have panelists that are still waiting to testify. Go ahead.

Mr. ROHRABACHER. If I understand one of your basic arguments against moving forward right now with a standard, it is that it will cost billions of dollars to retool. But let me ask you this, that, is it not possible that if we move forward right now and we have a system that combines what knowledge we have now with a system that—a progressive system that will eventually take over, I guess, won't that possibly save us billions of dollars and produce billions of dollars' worth of wealth that would pay for the retooling that you see is necessary—would be necessary in the future?

Mr. LIEBHOLD. No. It would allow people who have invested billions of dollars already to—principally overseas, to recover their investments, and I am not sure that we want to stimulate an industrial policy in this country that rewards some misjudgment by our foreign competitors.

Mr. ROHRABACHER. But the only reason they would recoup this money is if there was some benefit to society—meaning if there was some value added to the process of the way we live and—

Mr. LIEBHOLD. The point is that the entire HDTV process has been cutting edge research all the way along. I think all the proponents will agree that everything that has come to the test process has been just on the edge of possibility. We are so close now to coming up with something that is going to be genuinely useful by all sectors of society that it is reasonable to argue for both economic benefits and social benefits that we take the final step rather than some sort of staged approach that is going to allow the further entrenchment of an obsolete technology.

Mr. ROHRABACHER. Well, that is a decision at least I believe should be made by others than Government, and if we let the market work I'm sure that either VHS or Beta will turn out on top, and it is better for perhaps the people out there making the decisions in industry to make that final decision.

With that, thank you.

Ms. ESHOO. Thank you. You always ask excellent questions.

If I might just ask a quick one, I am very interested in the Grand Alliance and the work that you have done. Did you invite the computer industry—the Apples, the others—to be a part of the Grand Alliance? It is a charming name. I don't know who came up with this but obviously had a great deal of self-esteem for one another or yourselves—right?

Mr. GRAVES. I think it was—

Ms. ESHOO. But not to diminish that, did you invite others to be a part of it? and, if so, terrific; and, if not, why?

Mr. GRAVES. I think the credit for the name goes to Dick Wiley, the chairman of the Advisory Committee, and in fact—this is detailed in my written testimony—we received an awful lot of encouragement from Dick Wiley and other members of the Advisory Committee and from the FCC. I think they saw an awful lot of merit in the different systems, and they were not anxious to declare three losers and one winner when they saw so much merit in the other three systems, and so they said to us, "You know, what we'd really like is to combine all of the—we'd like one from column A and two from column B and one from column C," and really the Grand Alliance is a combination of all of the remaining proponents, and the Advisory Committee was not very—was much less interested in an alliance that would have left one of the parties out. They encouraged us to bring everyone together. Now in doing this—

Ms. ESHOO. If I could just interrupt for a moment, AT&T is a communications company, and I guess it can be said that it is computer as well, and is that what filled that slot or that definition so that you can say all of the bases were covered?

Mr. GRAVES. No.

Ms. ESHOO. Because in my view it wasn't, most frankly.

Mr. GRAVES. You see, I think what you need to understand is that the Advisory Committee in 1987 set up this whole process with representation from many different industries, but then there were—

Ms. ESHOO. And there wasn't the flexibility to move around and include others?

Mr. GRAVES. It does, and it has made changes over time.

But the point is, there were specific companies that proposed systems. There were 23 proposals initially. Over time, this was whittled down to four remaining proposals. But it is the Advisory Committee that has this broad representation and brings all these groups together, and the goal of the so-called proponents is to say, "Here's a system that we think meets the needs you have outlined, the requirements this Advisory Committee has outlined." So it is really the Advisory Committee that is in charge of this whole process under the authority. It was set up by the FCC. So it is the Advisory Committee and the FCC laying out requirements for a standard, and we as proponents were competing to try and be the winner for that standard, and at the encouragement of the FCC and the Advisory Committee we got together with a single proposal that we hope they will accept as the best way to go forward.

Ms. ESHOO. I still think that there is something missing, but I appreciate your answer.

Dr. CARNES. I would like to clarify a moment. There has been an advisory committee process—and I think you were absent when I earlier talked about the openness of that process and the fact that the computer industry has been represented on that Advisory Committee. In fact, Mr. Liebhold himself has been a member of some technical subcommittees on that process, and they have been guiding—

Ms. ESHOO. But are they part of or representative of the Grand Alliance, because you are the ones that are coming up with the standard or recommended standard, aren't you, to us?

Dr. CARNES. The Advisory Committee has been setting criteria for the system, and they have been evaluating the various proposals. To be a proponent, one had to submit a proposal, and there were 23 different proponents in 1987, and this list got whittled down, and whittled down, and whittled down, and people who were proponents have been investing tens of millions of dollars over the last six years to get to the point where they are. They have been players in developing digital technology, and the only four people who are in the Grand Alliance are the four remaining proponents who have been players over the last six years in spending a lot of money developing these techniques.

The computer industry has been part of the Advisory Committee process from the beginning and has been—

Ms. ESHOO. But not money players. That is what you are saying.

Dr. CARNES. They have not been investing in developing these techniques.

Ms. ESHOO. Okay. Well, I appreciate that. I think that obviously the task of the Committee, of this Committee, is going to be to ferret out all of this and to hopefully make a statement to the FCC that is going to benefit overall the best interests of our Nation, understanding that there are corporate players, recognizing that you have put money into this. You have your interests. We have to come up with the best interests of the Nation.

So I would like to thank this panel for a very enlightening and stimulating discussion and invite—let's see. Maybe we should be taking a break to go and—recess to cast votes and come back upon completion of those votes.

Mr. ROYCE. Yes. I have no questions, Madam Chair. I think now would be a good time to take a break.

Ms. ESHOO. Okay. We will invite the second panel to come to the table when we come back.

Thank you for your patience, and thank you to the witnesses that just completed their testimony.

[Recess.]

Ms. ESHOO. We will reconvene our hearing and invite our panelists to take their place at the table, and we will begin with Mr. Howard Miller, but of course we will wait for him to get in his seat.

Thank you for your patience in waiting this time—all of this time. Welcome.

STATEMENTS OF HOWARD MILLER, SENIOR VICE PRESIDENT, BROADCAST OPERATIONS, ENGINEERING, AND COMPUTER SERVICES, PUBLIC BROADCASTING SERVICE, ALEXANDRIA, VIRGINIA; ROBERT C. HUMMEL, VICE PRESIDENT, ANIMATION TECHNOLOGY FOR WALT DISNEY TELEVISION ANIMATION, NORTH HOLLYWOOD, CALIFORNIA; AND W. RUSSELL NEUMAN, PROFESSOR OF INTERNATIONAL COMMUNICATIONS AND DIRECTOR OF THE MURROW CENTER, TUFTS UNIVERSITY, MEDFORD, MASSACHUSETTS

Mr. MILLER. Thank you, Madam Chairman.

I am Howard Miller, and I represent Public Broadcasting. I have the responsibility for our operations nationally, our engineering, and also our computer services. I would point out that Public Broadcasting is probably the largest creator of original programming both electronically and film-wise for original creation of any of the broadcast organizations. We represent and support a huge Government investment in broadcast distribution, larger, in fact, than any of the commercial networks. These investments have been made on the part of the U.S. Government to provide educational material and other materials to the American public, and we also try to represent the interests of the educational institutions, and we are there also the largest provider of video-based education. So we are trying to wend our way through this as everyone else is.

The broadcasting and cable industries, including noncommercial and commercial entities, have invested millions of dollars in the development of a world class broadcast HDTV standard, and great progress has been made. Countless man hours from firms representing all relevant industries have been devoted to support of the current FCC Advisory Committee Test Center process. This process, in our opinion, has remarkably served to address the balance of the competing needs of all media.

With the recent formation of a Grand Alliance, North America has a chance to establish the most technologically advanced television system in the world. The Grand Alliance may result in even greater strides toward a final HDTV standard that will be the envy of the other nations, but fundamentally it should remain responsive to the needs of domestic industries through guidance provided by the FCC, the Advisory Committee, and this test center process.

While there is an apparent tension between the aspirations of some segments of the computer industry seeking immediate and total interoperability and the needs of television viewers as reflected in the potential cost of HDTV receivers, there is substantial compatibility between these two interests.

We in the television industry welcome and have worked toward that compatibility, and this compatibility is reflected in the Grand Alliance proposal which appears to embrace the concept of interoperability with all media and to be quite computer friendly.

The entire country has been awakened to the prospects for a new telecommunications data highway, and many believe this highway will be ushered into existence by digital and advanced television. Public television shares this view. We are already hard at work creating many exciting, new, interactive, and multi-media educational services to take advantage of such a telecommunications highway.

Lest we get carried too far too fast by this optimism, however, public television also feels a responsibility to sound a few notes of caution on behalf of the general public and the television industry. First, for all the industry-driven optimism, there has been very little positive evidence to indicate that the general public will embrace many of these new services and technologies. In fact, past attempts to launch such services have failed, and the involved companies have lost many millions of dollars. The services which have succeeded typically serve very specific and usually very affluent professional segments of our society.

While many computer futurists envision the all-digital advanced television sets as highly capable or large-screen computers, we suspect that for the general public television will remain an essentially passive entertainment medium for many years to come. To us, this means that the FCC proceeding on ATV should not be crafted in a way which tries to force the general public to pay for all the enhanced computer-like features which many may not want or cannot afford. Such features should remain a matter of personal choice to the maximum extent possible. This is the best way we can help to assure that all Americans will be able to share in the opportunity to benefit from the publicly owned broadcast spectrum.

The second issue concerns some very difficult technical trade-offs between the shared desires for interoperability and much higher video quality. In establishing the ground rules for development of broadcast ATV in the United States, the FCC has instructed that the new channel band widths must be identical to those used for existing television services. European band width is one-third greater. Japan has allocated even more band width to their HDTV services by resorting to a nationwide satellite delivery system.

Unfortunately, the available band width will limit the delivered video quality even in the digital world. A direct consequence of the North American limitations will result in recognizably lower quality ATV pictures than the future digital ATV services being provided for Europe or Japan. Our quality problems are being magnified even further as we seek higher levels of interoperability.

Interoperability features come at the expense of data bits which could otherwise be used to further improve video quality. Even so, we all support these key features which are being incorporated within the proposed Grand Alliance ATV system to accommodate the merging television and computer industry interests.

While all of us hope for future coding technology improvements to further alleviate some of our quality problems, such improvements are by no means a certainty. Therefore, in order to minimize an obvious quality disadvantage for our country, we must continue to seek the highest video quality at the outset as well as good interoperability.

The competing needs for the very limited channel band width will call for reasonable compromise. In our opinion, the Grand Alliance and the FCC Advisory Committee have been doing a very good job in crafting such a compromise. Thus, computer concerns have been the principal focus of one of our Advisory Committee's key working parties, and interoperability and the other computer-related considerations are among the ultimate selection criteria being used by the Advisory Committee.

Regretfully, a few in the computer industry would have the FCC force us to go much further. They would have us sacrifice substantially more video quality in order to make this network better serve their additional data processing and transport interests. Some of the same people would even have us degrade our video production quality to achieve these aims.

We are becoming quite concerned that the excessive interoperability demands may be placed upon the initially introduced ATV service. Excessive initial demands by any single industry segment could result in a failure of the new ATV service we are all trying to launch. Television receivers could prove to be too expensive for large portions of our population. For those who could afford them, they may not offer sufficient quality advantages over digitally distributed conventional television.

The FCC Advisory Committee process has succeeded so far because it has been based upon a balanced industry consensus. We strongly urge that this balance be maintained through the FCC Advisory Committee and the FCC itself and that all parties be prepared to accept the types of compromises which have been hammered out within the Advisory Committee over several years of difficult study and test. If we fail to work together, all this work could have been wasted and the United States risks once again slipping behind our international competitors.

Thank you.

Ms. ESHOO. Thank you, Mr. Miller.

Next we would like to call on Mr. Hummel. Welcome.

Mr. HUMMEL. Hello. My name is Rob Hummel. I'm vice president of animation technology for Walt Disney Television Animation. I come from mainly the arena which some might call old technology, I'd call mature technology. I'm a member of the American Society of Cinematographers—

Ms. ESHOO. That's what they say about people, too.

Mr. HUMMEL. The main thrust is that the largest installed software base—if you want to call it that—of entertainment media is based—is in film. We have 60/70-odd years of viable—let's say 60. "Snow White" is about 55 years old. It is about ready to be ready to be rereleased again. Fortunately, it was recorded on progressive film scan medium.

The thing about interlace that I am concerned about is, are we locking into a technology that is the most viable technology for the moment when, in fact, maybe just shortly down the road we can accommodate progressive scanning technology? I am aware that everyone is going after 1,000-line progressive scan imaging. That is the goal, and right now we will be happy with a 1,050-line interlace as being an intermediate transmission.

I am concerned that the production community will lock into this interlaced standard and it will be difficult for them to transition or maybe just not difficult, they will resist because they will have invested in so much interlace. The main concern being interlace cameras being able to record the medium, when right now I see that mainly in live video events. AT&T-Zenith's initial system proved that they can broadcast a 787 progressive line system which is more than adequate.

NHK did the most pioneering research in HDTV, which—we owe a lot of thanks to the Japanese. We probably wouldn't be sitting here today to talk about advancing the technology if it weren't for what they did. However, unfortunately, they anchored their technology in 1972, and in a 1982 published technical monograph by NHK they listed their results. The results were, well, progressive is better, progressive is the best way to go, but we don't have the amplifiers or the band width to be able to accommodate it. Progressive around 900 lines they said would be the best way to proceed, but we can't do that, so let's do interlace at 1,125 60 hertz. However, 1,125, if you do your math, according to this NHK monograph, equals about 60 percent of that, is what you have in an actual resolution on the screen.

So we shouldn't fool ourselves by saying 1,050. It isn't 1,050 lines, it is more closer to 630 lines, not even equal to the resolution of 787 progressive of the initial AT&T-Zenith proposal.

I am just concerned because in images that I have seen when Eastman Kodak had a 1,125/60 interlace set and they were showing some high resolution display images recorded off of film, that the images displayed interlace artifacts of buzzing even despite the high resolution imagery mainly because the even and odd line scanning, your even lines are scanned only at 30 times a second, the odd lines are scanned at another 30 times a second, which is below the threshold which your eye can conceive as far as a flicker rate.

Again, I'm not as much of an expert as Mr. Miller and these other people who have talked to you, because I come from the film industry, but just you should know, at the Montreux Film Festival in Europe just last week—the week before last, Warner Brothers, Universal, Disney—I'm forgetting another studio in there—all signed a document which the motion—those studies want supporting a system that will eventually end with 1,000-line progressive, that they want to avoid interlace because they feel interlace scanning compromises their imagery.

If "Jurassic Park" were interlace projected up on the screens in motion picture theaters right now, people would run out of the theater screaming at the flickering that they would perceive upon the screen.

Ms. ESHOO. They are running out screaming out anyway.

Mr. HUMMEL. Yes, that's a good point. That's why I didn't take my daughters.

I don't think—we have a situation here—and cut me off if I go over, because I am really not adhering to this because I have learned a lot here today myself. HDTV—John and Jane Doe in Sioux Falls, South Dakota, aren't saying, "Honey, turn off the set. It's so low resolution, I can't take it any more." The general public out there doesn't even know they are looking at low resolution. They are going to Good Guys and Circuit City and buying Mitsubishi big screen TV's which, me, coming from the film arena, I look, and I go, "Ugh," but other people look at them, and they go, "Oh, isn't that neat," and they have no idea of the low-res they are looking at. HDTV is in some ways—as far as from the consumer's point of view, is a solution in search of a problem, because the consumer out there doesn't have a problem.

I think we should proceed this way. I think that we are offering technology because of what Liebhold was addressing earlier. We are coming into this age of interactive media, and we are right on the cusp of an explosion of this stuff. Many film studios, including the one that I work for, are getting ready to develop interactive media where they want to have the best displayed images on a screen along with text and other graphics. If you record that image in an interlace system, the band is going to be displayed with progressive scan text, you are going to require the consumer to absorb the expense of having chips in there that interpolate that interlace image and make it progressive so it can be displayed with text simultaneously. That is one of my concerns.

As far as live camera feeds, whether they have to be full resolution, you might want to weigh things, and this is off the top of my head here, but already consumers don't complain about VHS being lower resolution than their sports broadcasts because most people don't even realize it is lower resolution. It is about half the resolution of broadcast.

And earlier it was mentioned about the VHS/Betamax debate. That was settled between manufacturers. One manufacturer wanted to keep it proprietary, Betamax, which is the superior format. The manufacturer decided to license it out at a very low price. So the lower quality format won out.

Fortunately, here what we are trying to do is establish a standard for this country that will force the manufacturers to aim for the best standard. Sometimes—don't leave it to the manufacturers because sometimes the manufacturer that lowballs the higher standard is the one that wins out. Does that make sense?

Ms. ESHOO. That may be a prophetic statement that you just made in this hearing, in my view. Are you finished?

Mr. HUMMEL. Yes.

[The prepared statement of Mr. Hummel follows:]

Robert C Hummel
Vice President, Animation Techaology
Walt Disney Television Animation
North Hollywood, California

Testimony for Subcommittee on Technology, Environment, and Aviation

- I want to speak to the issue of there being a system initially based on Interlace scanning.

First of all, we wouldn't be here today if it weren't for the pioneering efforts of the Japanese in the arena of HDTV. The only sad thing for them is that they laid the foundation for their HDTV system at a time when the technology didn't exist that could support a higher quality progressive scanning system.

Basically, an idea that was so far ahead of its time, the technology couldn't support the absolute highest quality. In NHK's (Japan Broadcasting Corporation's) Technical Monograph dated June of 1982, their findings were that although progressive scanning yielded images of noticeable higher resolution and more effectively able to render fine details, they ended up choosing Interlace scanning as a method of preserving bandwidth. Not the best method, but with 1125 lines, it would have been better than NTSC, and the public had already shown that, while many didn't understand when they were seeing interlace artifacts, clearly the public had grown to accept them.

So, Interlace scanning, a method of display adopted in the 1930's for Television, was adopted again in the early '70's for the same reason: namely the technology didn't exist that could handle the requirements of progressive scanning.

Today it is different. Have you compared a computer of twenty years ago with one of today? For the same reason, we should immediately grab a hold of the technology of the future! Especially since we now have affordable Technology that can easily accommodate a progressively scanned image. A transition to progressive means more money spent by the consumer and the video production industries to accommodate the transitional period. Embarking immediately to progressive means investments by both consumers and the industry in technologies that tend to be future proof.

- Motion pictures are technically speaking, a progressively scanned image. We have all seen a performer on television that has worn a striped tie or outfit that "buzzes" with vibrations on our screen. That buzzing is an interlace artifact.

You have never seen that type of artifact in a motion picture. Because it is a progressively scanned image.

Progressive is also more cost effective for film producers. With a digital progressive system, I can produce a drama at 24 fps and shoot high action sports at 60 or 72 fps and have a box on the receiving end that easily smart enough to interpolate those images and display each of them properly. With interlace I have no choice. I *must* display at precisely the interlace standard frame rate, or risk running into compromises.

FROM SPROCKETS TO SCREEN

Understanding the Technology and Expressive Potential of the Film Medium

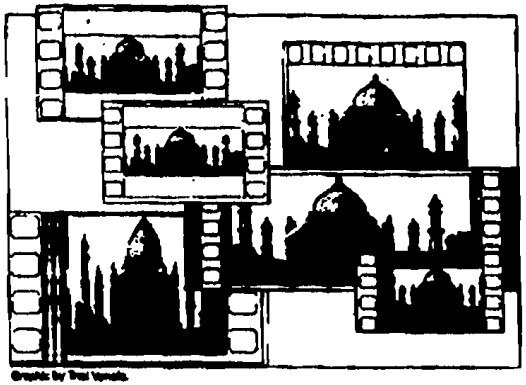
Cinematographers, producers, post-production supervisors, and production executives responsible for making the creative and technical decisions integral to completing film projects must have a thorough understanding of their medium in order to fulfill their objectives and uphold the highest professional standards.

This course provides a comprehensive foundation in film technology and processes, from pre-production through film preservation for future exploitation.

Lectures, demonstrations, discussion with guest speakers, and field trips are coordinated by **Bob Hummel**, currently the director of production operations for Disney Imagineering's Theme Park Productions. His previous positions have included director of production services for the Professional Film Division at Technicolor, director of post-production at Walt Disney Touchstone Pictures, and production consultant and lab coordinator for Walt Disney Productions' Tron.

PROGRAM

- **Defining the Film Medium:** History, Manufacture, Chemistry, Sensing and Perforation, Speed, Color Photography, Printing



Graphic by Thad Vanella

- **Film Formats:** Animation and Successive Exposure, Sprockets, Film Widths and Sizes, Major Film Manufacturers and Film Stocks
  Speaker: *Steve Poster, ASC,* Director of Photography, *Someone to Watch Over Me, Rocky V, Cemetery Club*
- **Choosing a Format for Photography:** Creative Options and Compromises
  Speaker: Harrison Ellenshaw, Vice President, Walt Disney-Buena Vista Visual Effects
- **What Happens After Release:** Foreign Markets, Video Versions, HDTV, 30 fps vs. 24 fps Photography, Special Venue Formats—Showscan, IMAX, Iwerks, Vista Vision
- **Format Comparison Screening**
  Speaker: *Woody Omens, ASC,* Director of Photography for *Harlem Nights, Coming to America, An Early Frost,* and many others.
- **Preserving Film for Eternity:** YCM Protection Masters
- **Color Timing at the Lab:** The Answer Print—Who Has Final Say, Dupe Negatives, Special Laboratory Techniques
- **The Glasses for the Cinematographer:** Photography, Lighting, Exposure, Lenses, Color Saturation, Graininess, Film Printing
  Speaker: *Steven H. Burum, ASC,* Director of Photography, *Hoffa, Raising Cain, The War of the Roses, The Untouchables,* and *Rumblefish*
- **Communicating with the Film Laboratory:** What Happens to a Roll of Film as It Travels Through a Lab?
  Field trip to a major laboratory
- **Problems on the Set and in the Lab:** Dirt—Emulsion, Base, and Manufacturing; Handling; Scratches
- **Gamma, Lab, and Manufacturing:** Flicker—Shutter, HMI, Fluorescence, and Neon
- **Film Exhibition—A New Set of Variables:** Future Masters, the Future of Entertainment, Shortcomings of Magnetic Media, Future Recording Media

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Walt Disney Television

Rob Hummel
Vice President
Animation Technology

Lucy Richards
Committee on Science, Space, and Technology
Via FAX: (202) 225-7815

Rob Hummel Biographical Sketch:

Rob Hummel is currently Vice President of Animation Technology for Walt Disney Television. In this capacity, Rob is charged with directing the Television Animation division in reviews of New Technology that can be of benefit to Disney, such as digital ink and Paint and digital film printing.

A member of the corporate New Technology Committee, Rob deals with many divisions of the company helping advise in areas of technology that relate to motion picture and television production and post production.

Rob started with Disney overseeing Post Production for Walt Disney and Touchstone Pictures. He then acted as producer for the animated feature *Duck Tales, The Movie*, served as Director of Production Operations for the film production unit of Walt Disney Imagineering, and, prior to his current position, was the Visual Effects Supervisor for the upcoming Touchstone film *Cabin Boy*.

Rob has also worked for Technicolor as the principle liaison between the laboratory and many of the most prominent Directors and Cinematographers in the film industry.

Some of the films that Rob has been involved with at Technicolor and Disney were:

Gremlins	Apocalypse Now	Raging Bull
Innerspace	The Black Stallion	Explorers
Witches of Eastwick	The Right Stuff	Back to The Future
Star Trek IV	Rambo III	Tucker
Beverly Hills Cop II	Silverado	Accidental Tourist
Cape BO	Beetlejuice	Short Circuit
Little Mermaid	Oliver & Company	New York Stories
Pretty Woman	Manhattan	Dead Poets Society

He also supervised [illegible] production and final effects compositing for the film *TRON*; and managed a visual effects facility that produced visuals for the film *Blademunner*.

Rob is a member of the American Society of Cinematographers, S.M.P.T.E., The Technology Council of the Motion Picture Industry, has spoken on panels at a number of entertainment conferences dealing with future technologies and entertainment, had a number of articles published in film and technical journals, and teaches a unique course at UCLA Extension that relates to his specific areas of expertise.

[illegible] Burbank/North Hollywood, California 91604/818 954-7239/Fax 818 752 9833

Part of the Magic of The Walt Disney Studios

Ms. ESHOO. I admire you for just sitting there and speaking to us instead of looking at something, which is difficult to do, given the complexity of what we are talking about. So I especially appreciate it, and I have some questions that I would like to ask afterward. But first we will go to Professor Neuman, with our thanks to Mr. Hummel.

Professor Neuman.

Mr. NEUMAN. But Disney didn't bring any costumed characters to illustrate their points.

Mr. HUMMEL. They are outside.

Ms. ESHOO. He doesn't need to. Everyone knows what—

Mr. NEUMAN. Mickey Mouse.

Ms. ESHOO. That's right—Mickey Mouse. Some on this side, too, right? That is what most people believe anyway.

Please, begin.

Mr. NEUMAN. Madam Chair, if I may consult my notes in front of me—

Ms. ESHOO. Sure.

Mr. NEUMAN. Because public policy at times of dramatic technical change and economic change is especially important, I would like to step back from the technical details of HDTV for a moment this morning and try to put the ongoing standards debate in a somewhat broader perspective. Also, as issues of electronic communications bridge the concerns of the science committees and the telecommunications committees in Congress, I will direct my remarks to some action items which may be most appropriately addressed by the Committee on Science, Space, and Technology concerning technology and competitiveness and future communications standards debates which will no doubt accompany the birth of the national information infrastructure.

At the outset of the American HDTV process when the FCC's Advisory Committee on Advanced Television Service, the ACATS Committee, and the associated notice of inquiry was published in the summer of 1987, the process was strongly dominated by broadcasters who, in my judgment, found themselves in a very defensive position. In fact, some Washington insiders insisted that the end game of the broadcasters in 1987 was to identify HDTV as the television of the future and to use its perceived spectrum requirements as a defense against mobile radio interests who were pressing for access to the underutilized UHF spectrum while, in fact, dragging their feet on actual development of HDTV.

Advanced television in the ACATS process at the outset was narrowly defined as a means for providing traditional terrestrial broadcasters with a somewhat sharper and wider video image. The concept of using evolving compression technologies to provide a greater diversity of channels and more program choice, the issue of transmission over telephone, computer, satellite, and even cable networks, and the issues of cellular and digital transmission architectures were either dimly perceived or quickly dismissed. The broadcasters warily judged HDTV to be all cost and almost no economic benefit.

Ironically, as the broadcasters dragged their feet, the process took so long, the adjacent industries, from which we have heard today, began to realize what was at stake. The cable, satellite, tele-

communications, and finally the computer industry increased their participation in the ACATS working committee process in hopes of broadening the definition of what advanced television might actually become, and, as it turns out, in large measure they have succeeded.

The discussion today of the Grand Alliance HDTV transmission standard and its implications for interoperability, extensibility, and scaleability, and the national information infrastructure, I would predict, will turn out to be one of the last rounds of an old debate, HDTV as TV—that is, Seinfeld in sharper color and CD quality sound—versus HDTV as NII, a digital electronic infrastructure of graphics, data, voice, interactive video, traveling over a network of networks, including broadcast spectrum, cable, telephone, and computer systems.

The HDTV, as TV-view, leads to an economizing mentality and cutting technological corners to make the cost per set and the cost per transmitter as low as possible. At the margin, interlace versus progressive makes little difference to the average station manager or the average Seinfeld viewer, as Mr. Hummel had drawn our attention to.

It is not until one enters the domain of larger displays, many of them not based on the CRT technology, graphics, and interactive imaging, that the long-term benefits of the more advanced progressive architectures are made evident.

My point this morning is that the success we have witnessed in the past two years in opening up the ACATS process was very much a lucky break, I would argue, a historical fluke. Had the Japanese equipment manufacturers or the American broadcasters moved a little faster, the original trajectory of the ACATS process in 1987 would have led us to a limited use, broadcast only system optimized to make interconnection with other systems impractical.

Given the remarks this morning, it is hard to recognize that that almost happened. It was due, in my judgment, to some fortunate timing and the heroic efforts and personal commitments of individuals on the Commission, on the Hill, in academe, and in the computer industry that a near disaster was averted.

I would like this morning to address my remarks to putting ourselves in the best possible position in future debates over technology standards and raise the issue of what aspects of this process fall most appropriately in the domain of this Subcommittee.

Technical standards debates are likely to be dominated by the interests of the most threatened or best financed established players. In future technical fora, as the architecture of the national information infrastructure is developed, it would be fruitful, in my view, to draw on independent expertise and fresh ideas from academe, independent research institutes, and some smaller start-up ventures. They are potential players whose resources are often too limited to support participation in the working parties and the technical testing cooperatives so important to a technical standards process.

There is a role for the FCC and the NTIA to play in stimulating new participation. The oversight for those agencies, however, falls to the House and Senate communications committees. I would like to propose this morning, nonetheless, a new initiative in the do-

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main of science and technology to facilitate an opening to new technical vision and to guard against possible capture by established interests. I am not sure what the optimal operational form might be, but a new program in the National Science Foundation and a parallel new program in the National Institute of Standards and Technology could be undertaken. The purpose of these programs would be to support and facilitate the participation of independent academic expertise, scientists from the National Labs and smaller research institutes, and from smaller venture firms otherwise unable to meaningfully participate in the design and testing of the national information infrastructure.

My purpose in speaking this morning is to step back from the details of the Grand Alliance and the debate over progressive and interlaced scan and treat this as a case study for informing future activities and legislative initiatives by this Committee and Subcommittee.

If I may, if you would allow the professor to make one reading assignment before concluding, there is a book recently published by Nathan Rosenberg and L.E. Birdzell at Stanford which studied the unique capacity of American industry to extract economic benefit from technical change. Their study encompasses two centuries of technical and economic evolution in the United States, Europe, Japan, and the Third World. What was the secret of America's unparalleled long-term success in adjusting to and benefiting from the successive waves of technical change? It was the openness of the system, a lack of authoritarian orthodoxy, the lack of a priesthood or ruling elite or Government-industry cabal which could dictate the path of change to serve established interests.

I commend to the subcommittee's attention a new legislative initiative to broaden the participatory structure of the standards process for these next rounds so we are not dependent the next time on good fortune and propitious timing.

Thank you.

[The prepared statement of Mr. Neuman follows:]

Public Policy in Response to Dramatic Technological Change: A Case Study of HDTV and the Grand Alliance Standard

Testimony before
The Subcommittee on Technology, Environment, and Aviation
Committee on Science, Space, and Technology
United States House of Representatives
June 24, 1993

W. Russell Neuman
Edward R. Murrow Professor of International Communications
The Fletcher School of Law & Diplomacy
Tufts University
Medford Massachusetts

It is relstively rare in human history that we grasp the significance of the events which swirl about us as they occur. It was, for example, 100 years after the beginning of the industrial revolution in the West before the term "industrial revolution" was first used to try to encompass the magnitude and breadth of the changes underway. A few years before, Bell's invention of the telephone was dismissed as an electronic toy. We are in great haste, critics argued, to connect Maine and Texas electronicslly, but it may be that Maine and Texas have nothing important to communicate.

Because public policy at times of dramatic technical and economic change is especially important, I would like to step back from technicsl details of HDTV for a moment this morning and try to put the ongoing standards debate in a somewhat broader perspective. Also, as issues of electronic communications bridge the concerns of the science committees and the telecommunications committees in Congress, I will direct my remarks to some action items which may be most appropriately addressed by the Committee on Science, Space, and Technology concerning technology and competitiveness and future communications standards debates which will, no doubt, accompany the birth of a National Information Infrastructure.

My story begins with the establishment of the FCC's Advisory Committee on Advanced Television Service and the associated Notice of

Inquiry in July of 1987. In retrospect, this document, only six years old, is remarkable in its narrowness of scope and insight. It is explicitly defensive in its tone, reflecting the fact that the Commission was responding to a petition of broadcasters concerned with the prospect that the new HDTV technologies under development in Japan, if adopted here, might increase the cost of broadcasting, create competition for broadcasters or reduce broadcasters' control over the allocated broadcast spectrum. In fact, some Washington insiders insisted the end game of the broadcasters in 1987 was to identify HDTV as the television of the future, and to use its perceived spectrum requirements as a defense against mobile radio interests who were pressing for access to the underutilized UHF spectrum while dragging their feet on the actual development of HDTV.

"Advanced Television" was narrowly defined as a means for providing traditional terrestrial broadcasters with a somewhat sharper and wider video image. The concept of using the evolving compression technologies to provide a greater diversity of channels and more program choice, the issue of transmission over telephone, computer, satellite or even cable networks, the issues of cellular and digital transmission architectures were either dimly perceived or quickly dismissed much like the early days of the steam engine and the telephone.

It is not that the Commission and the active industry professionals lacked vision. It was simply in most participant's interest to force-fit these new technical developments into the existing

industry and regulatory structures. There was a delicate balance to be maintained between the powerful lobbies of the existing dominant carriers.

The broadcasters warily judged HDTV to be all cost and no economic benefit. Ironically as the broadcasters dragged their feet, the process took so long, the adjacent industries began to realize what was at stake. The cable, satellite, telecommunications and finally the computer industry increased their participation in the ACATS working committee process in hopes of broadening the definition of what "advanced television" might actually become. As it turns out, they have, in large measure, succeeded.

The discussion today of the Grand Alliance HDTV transmission standard and its implications for interoperability, extensibility and scalability and the National Information Infrastructure, I would predict, will turn out to be one of the last rounds of an old debate--HDTV-as-TV (Seinfeld in sharper color and CD-quality sound) vs HDTV-as-NII -- a digital electronic infrastructure of graphics, data, voice and interactive video traveling over a network of networks including the broadcast spectrum, cable, telephone and computer systems.

The HDTV-as-TV view leads to an economizing mentality and cutting technological corners to make the cost per set, and the cost per transmitter as low a possible. At the margin, interlace versus progressive makes little difference to the average station manager or the average Seinfeld viewer. It is not until one enters the domain of

large displays, graphics and interactive imaging that the long-term benefit of the more advanced progressive architectures are made evident.

My point is that the success we have witnessed in the past two years in opening up the ACATS process was a lucky break, an historical fluke. Had the Japanese equipment manufacturers or the American broadcasters moved a little faster, the trajectory of the ACATS process in 1987 would have led to a dead-end, broadcast-only system optimized to make interconnection with other systems impractical. It almost happened. It was due to some fortunate timing and the heroic efforts and personal commitments of individuals in the Commission, on the Hill, in academe and the computer industry that, in my view, a near-disaster was averted.

A number of my colleagues are concerned that as there remain a number of technical parameters yet to be negotiated in the Grand Alliance, an HDTV-as-TV view may yet prevail. In my judgment, the momentum on this issue has finally shifted. If a group of vendors decide to hastily introduce an interlaced half-HDTV, in hopes that broadcasters and consumers can be persuaded to buy first one generation of HDTV and then a second within a few years, they will simply be rejected by the marketplace. Such foolishness need not be precluded by legislation. Let them experiment.

I would like to address my remarks to putting ourselves in the best possible position in future debates over technology and industrial

standards and raise the issue of what aspects of this process fall most appropriately within the domain of the Science Committee.

Technical standards debates are likely to be dominated by the interests of the most threatened or best financed established players. In future technical fora as the architecture of the National Information Infrastructure is developed, it would be fruitful, in my view, to draw on independent expertise and fresh ideas from academe, independent research institutes and some of the smaller start-up ventures. These are potential players whose resources are often too limited to support participation in the working parties and technical testing cooperatives so important to the technical standards process.

There is a role for the FCC and NTIA to play in stimulating new participation. The oversight for those agencies, however, falls to the House and Senate Communications Committees. I would like to propose, nonetheless, a new initiative in the domain of science and technology, to facilitate an opening to new technical vision and to guard against capture by established interests. I am not sure what an optimal operational form might be, but a new program in the National Science Foundation and parallel new program in the National Institute of Standards and Technology could be undertaken. The purpose of these programs is to support and facilitate the participation of independent academic expertise, scientists from the national labs and smaller research institutes and from smaller venture firms otherwise unable to

meaningfully participate in the design and testing of the National Information Infrastructure.

My purpose in speaking this morning is to step back from details of the Grand Alliance debate for a moment and treat it as a case study, part of broader pattern of technical change which is and should be of central concern to this Committee and Subcommittee of the House. My colleagues Nathan Rosenberg and L.E. Birdzell at Stanford have recently published a seminal study concerning the unique capacity of American industry to extract economic benefit from technical change. Their study encompasses two centuries of technological and economic evolution in the United States, Europe, Japan and the Third World. What was the secret to America's unparalleled long-term success in adjusting to and benefiting from the successive waves of technical change? It was the openness of the system -- the lack of an authoritarian orthodoxy, the lack of priesthood, ruling elite, or government-industry cabal which could dictate the path of change to serve the established interests.

I have spent about half my professional life over the last decade engaged in the HDTV standards wars. I've observed the battles from an intimate distance. In my view the good guys won. The public interest has been well served. But in retrospect, it was a very close call. It could have easily gone the other way.

I commend to the Subcommittee's attention a new legislative initiative to broaden the participatory structure of the standards

process for the next rounds, so we are not so dependent on good fortune and propitious timing.

Ms. ESHOO. Thank you, Professor Neuman, and I appreciate your bringing into your testimony the distinguished writers from Stanford University, which I have the privilege of representing, so I'll make sure that I get the book.

Since I am the only Member that is here, I think that it would be selfish for me to ask you to remain here—because I need to go and vote—in order to ask you questions. So what I would like to ask is if you would be willing to accept questions not only from myself but if other members of the committee would like to, after reading your testimony, ask you to answer questions, would the three of you be willing to do that in writing if that is submitted to you?

Mr. HUMMEL. Certainly.

Mr. NEUMAN. I have also brought two additional papers which I would like to have added to the written record, if that is possible.

Ms. ESHOO. We would be glad to. We would be glad to.

So I would like to thank you at this time for traveling across the country to provide us with this testimony. We will make very good use of it. I'm sorry I don't get to ask you my questions in person, but you can be assured that I will submit them in writing.

Mr. HUMMEL. Madam Chairman.

Ms. ESHOO. Yes.

Mr. HUMMEL. There are some other things I wanted to say. Can I submit those things in writing as well?

Ms. ESHOO. Yes, absolutely. We would welcome them. We are going to need that, because this is a highly complex issue, and we are going to need all that you can provide us with, okay?

I hope that this has been a rewarding experience for you. It has certainly deepened my understanding and heightened my view of what at least I believe we need to do. Thank you.

At at this time, I would like to express my thanks to the committee staff. As I guess everyone here is aware, I'm a new Member of Congress. Lucy Richards has spent considerable and substantive time teaching me, and so has my good friend here. I would like to thank the staff because they are very able and have been very generous to me and I'm sure to other members of the Committee. So I would like to salute and commend them, and we will now end this Committee hearing so that I can go and cast my vote.

Thank you.

[Whereupon, at 12:42 p.m., the subcommittee was adjourned.]

APPENDIX

Technology Council of the Motion Picture-Television Industry

Phone/Fax 818/766-6660

12 June 1993
Montreux, Switzerland

To Whom It May Concern:

The largest single resource of quality high definition material is 35mm film, both in terms of existing libraries and new program production.

Currently, film is scanned and frame rate converted to each of a growing number of international distribution formats. Since the number of transfers will grow with the advent of high definition and widescreen formats, this method is not ideal.

It is possible, however, to create a digital recording format optimized for film-originated material, from which most other distribution formats can be electronically derived.

To capture the image structure and quality of film, such format would be 24 frames per second, greater than 1000 lines, and progressively scanned.

Our industry seeks such a common format.

The Technology Council of the Motion Picture-Television Industry and the member companies represented below will invite you to a future meeting to discuss our specific needs in a common format.

We believe these principles are achievable and should be considered in the design of your future recording devices. This is vital to reach across regional barriers and to achieve a common format for global program exchange.

We hope you will accept this invitation to establish a dialogue with us.

Sincerely,

Chris Cookson
Exec. Vice President, Technology Council of the Motion Picture-Television Industry
Sr. Vice President, Technical Operations, Warner Bros.

Richard J. Stumpf
Chair, Special Projects Group, Technology Council of the Motion Picture-Television Industry
Sr. Vice President, Engineering and Development, Universal City Studios

Joerg O. Agin
Sr. Vice President, New Technology Business Development, Universal City Studios

Bob Lambert
Vice President, New Technology and Development, Walt Disney Studios

Computer and Business Equipment Manufacturers Association 1250 Eye Street, NW Suite 200 Washington, DC 20005 (202) 737-8888 Fax (202) 638-4922

July 16, 1993

The Honorable Tim Valentine
Chairman, Subcommittee on Technology,
Environment and Aviation
U.S. House of Representatives
B374 Rayburn House Office Building
Washington DC 20515

Dear Representative Valentine:

I am writing on behalf of the Computer and Business Equipment Manufacturers Association regarding an issue associated with the development of a U.S. standard for Advanced Television ("ATV"). That issue concerns the extent to which the ATV system will permit the exchange of information among television, computer, and communications technologies ("interoperability"), and support and incorporate new functions and future technological advances ("extensibility"). Interoperability has, quite properly, been a critical goal of the Advisory Committee on Advanced Television and the ATV system proponents who have come together to form the Grand Alliance.

The benefits of an interoperable and extensible system are clear. Of greatest significance, such a system will allow ATV technology to be used for interactive education, expand the availability of advanced health care, promote productivity, and enhance the efficiency and effectiveness of government institutions. More generally, it will enable data, images, and video information to be widely available across the full range of consumer and business settings, in a form that is easily conveyed, manipulated, and viewed. In addition, an interoperable and extensible system will stimulate investment by U.S. computer and business equipment manufacturers in products and services that utilize digital display technology. The resulting economies of scale will reduce the unit cost of converting signals across disparate environments -- lowering expenses for broadcasters and likely expediting the deployment of ATV.

All affected parties agree that interoperability is an important goal, and much progress has been made toward achieving that goal. For example, the system being proposed by the "Grand Alliance" incorporates such key underpinnings of interoperability as digital signal transmission, data structured in "packets," a highly flexible data stream, and headers and descriptions in the data stream. Detailed technical review by the Advisory Committee's interoperability working group will be necessary to validate these features, but their importance is not disputed.

Of great significance, the Grand Alliance also proposes to migrate to a totally progressive scan system with square pixels, starting with an interim system using both interlace and progressive scanning. Progressive scanning, unlike interlace scanning (the current broadcast industry standard) enables smooth, sequential scanning of the lines of dots, or "pixels," on the display screen. Such smooth scanning is essential for many widely used communications and computing displays. Square pixels (where the columns and rows of pixels are spaced equally) are important for sharing a wide variety of picture information across industries and uses.

The Alliance's proposal accommodates the legitimate interests of the broadcast industry and allows the early deployment of ATV in the United States, while promoting and accommodating new technology that will enable the ATV system to achieve its full potential. At the same time, to assure continued smooth and timely progress toward interoperability, CBEMA believes it will be important to establish a specific, benchmarked migration path. Such a commitment to a specific migration path will ensure the ultimate goal of interoperability remains in focus and is attained in a timely manner.

As you and your subcommittee consider these important matters, I hope you will appreciate the substantial progress toward interoperability that already has been made and encourage the definition of a sound and clear migration path. If CBEMA may be of assistance in those efforts, please do not hesitate to call me.

Sincerely,

John L Pickitt

John L. Pickitt
President

JLP/amw

ELECTRONIC INDUSTRIES ASSOCIATION

July 15, 1993

Honorable Tim Valentine
Chairman
Subcommittee on Technology, Environment & Aviation
Committee on Science, Space & Technology
B374 Rayburn House Office Building
Washington, D. C. 20515

Re: June 24, 1993 hearing on High Definition Information Systems

Dear Mr. Chairman:

The Electronic Industries Association (EIA) is pleased to submit its views for the record of the June 24, 1993 hearing held by the Subcommittee on Technology, Environment & Aviation on High Definition Information Systems.

EIA is the oldest and largest trade association for the U.S. electronics industry, and is comprised of more than 1,000 member companies involved in the design, manufacture, distribution and sale of electronic parts, components, equipment and systems for use in consumer, commercial, industrial, military and space use. Overall, the industry was responsible for more than $285 billion in factory sales of electronics in 1992 and employed nearly 2 million Americans.

Both EIA and its members have a long-standing involvement in this important issue and stand ready to work with you and the Subcommittee in advancing high definition technology. Should you or your staff have any further questions concerning the enclosed testimony or the ongoing activities of the EIA Advanced Television Committee, please feel free to contact Mr. John J. Kelly, Vice President, Secretary & General Counsel, Electronic Industries Association, 2001 Pennsylvania Avenue, N.W., Washington, D.C. 20006-1813. For your convenience, Mr. Kelly may be reached by telephone at (202) 457-4917.

Sincerely,

KEVIN C. RICHARDSON
Vice President
Government Relations

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enclosure
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2001 PENNSYLVANIA AVENUE, NW • WASHINGTON, DC 20006-1813 • (202) 457-4900 • FAX (202) 457-4985

UNITED STATES HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY

102D CONGRESS
1ST SESSION

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HEARING ON HIGH-DEFINITION TELEVISION

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PREPARED TESTIMONY OF

SIDNEY TOPOL, CHAIRMAN
ADVANCED TELEVISION COMMITTEE
ELECTRONIC INDUSTRIES ASSOCIATION

* * * * * *

JUNE 24, 1993

Mr. Chairman and members of the Committee, I am glad to have the opportunity to discuss developments in high-definition television ("HDTV") and to address related issues of economic growth in the United States.

Introduction and Interest of EIA/ATV Committee

By way of background, I would like to begin by describing the EIA/ATV Committee, which I am privileged to chair. The Committee was established in 1988 by the Electronic Industries Association ("EIA"). The Committee's primary purpose is to promote dialogue and consensus regarding the development and implementation of advanced television ("ATV") in the United States.

Our Committee encompasses a broad and diverse array of companies. Members include developers, manufacturers, sellers, and installers of a wide range of products, including equipment and components used in broadcast, cable, satellite, telecommunications, and consumer electronics. Inevitably, because of their differing roles in the marketplace, individual members of the Committee hold their own distinct views on many of the issues relating to ATV. The Committee takes positions only on matters concerning which we have developed a consensus.

The EIA/ATV Committee has proved to be a useful forum to address various ATV issues. We have participated in all phases of the Federal Communications Commission's ongoing rulemaking proceeding to

establish rules and policies for advanced television (MM Docket No. 87-268). We have cooperated with the Advisory Committee on Advanced Television, the Advanced Television Test Center (of which EIA is a sponsor), and other organizations to help promote development, standardization, and deployment of ATV in the United States. Our 1991 Statement of Principles (copy attached) has helped to stimulate and to focus the development of public policies to encourage ATV. So, too, has our February 1989 study -- "Consumer Electronics, HDTV, and the Competitiveness of the U.S. Economy" -- which was submitted to the Congress four years ago.

I will discuss this study in greater detail in a few minutes.

A Time of Unique Opportunity

The months of May and June 1993 marked a critical juncture in the development of advanced television. Just one month ago, after arduous negotiations, the proponents of the ATV systems that had been vying for selection by the Advisory Committee and the Federal Communications Commission forged agreement on a single system. This "Grand Alliance" apparently represents a combination of the best features from the several systems. The agreement holds the potential to avert additional expenses and delays that might otherwise have had devastating effects. The agreement makes it possible for the United States to maintain its momentum -- and retain the worldwide lead -- in the development of a

digital television standard suited to the needs and capabilities of the 21st Century.

The agreement represents an enormous stride forward, and it is timely to celebrate the leadership, cooperation, and other factors that made this achievement possible. We salute Dick Wiley, Dennis Patrick, Al Sikes, Jim Quello, and the countless others who have brought us to this milestone. We pay tribute, most of all, to the scientists and engineers who have labored so long to turn their dreams into reality.

But we must not lose sight of the very substantial work that lies ahead. It is not agreement by the proponents or approval of that agreement by the Advisory Committee or the Commission that will make HDTV available to American consumers. Only the initiation of HDTV transmission can do that.

Likewise, standardization of a system and completion of the policymaking process are important near-term objectives, but they alone cannot trigger massive investments in new broadcast equipment, television sets, cable and satellite equipment, semiconductors, and related products and components. The economic stimulus that HDTV can provide will result only when HDTV services and products are readily available in the marketplace.

A New Goal, A New Challenge

The EIA/ATV Committee believes it is timely to establish, as a national goal, the objective of commencing HDTV delivery to American

homes by the Summer Olympics in 1996. We ask the Congress, the Commission, and all interested parties to consider this proposal carefully. We hope you will adopt it as your own.

No event so captures the human imagination -- or so favorably mirrors the human spirit -- as do the Olympic Games. The Summer Games in 1996 will be the first Olympic games to be held in the United States since 1984, and they may be the last to be held here until after the Millennium. The Summer Games will provide an exceptional opportunity to demonstrate the many special qualities of HDTV, in vivid contrast to the limitations of today's NTSC broadcast standard. Swimming, diving, track and field, these and other events -- if available via HDTV broadcasts and receivers -- will powerfully illustrate the more natural aspect ratio, the truer colors, the crisper sound, the freedom from artifacts, and the much improved resolution inherent in HDTV. And, as the Olympics showcase American athletes competing in an all-American city, it is fitting that this gold medal technology, developed in the United States, should also be featured.

We are aware of no other event that has as much potential as do the Olympics to serve as a catalyst for consumer demand for HDTV. This demand can accelerate HDTV implementation in a way that shaves years off the transition -- and substantially increases the prospects for long-run success of this new technology. We do not doubt that interested parties possess the commitment, the skills, the leadership, and the cooperative

spirit necessary for HDTV to succeed. But a bold timetable is certain to bring out the best in all participants.

HDTV and Economic Growth

The focus of this hearing is on the relationship between HDTV and economic growth. In preparation for this hearing, we have had occasion to review the detailed report we submitted to the Congress over four years ago. We are pleased to see how relevant it remains.

Our report emphasized the proposition that competitiveness is primarily an economy-wide issue and that promotion of economic growth in numerous industries can best be effectuated by way of broad-based policy measures designed to promote investment in physical plant, knowledge, and human capital. Based on that premise, we advocated several aggregate policy initiatives relating to the budget deficit, tax policies, antitrust laws, and international trade. We are delighted that many of these proposals are now included in the Administration's economic policy.

The portion of our report that may be more specifically relevant to this particular Committee discussed the role of electronics in U.S. competitiveness, including linkage impacts and technological spillovers. We also discussed the role of consumer electronics within the larger electronics industry, elaborating on upstream and downstream effects and manufacturing techniques. We explained how progress in HDTV will

influence U.S. performance in the computer, defense, and telecommunications industries.

We continue to believe that the early introduction of HDTV will provide needed stimulus to the U.S. economy. At a minimum, HDTV will create jobs for American workers in the design and manufacture of HDTV displays, integrated circuits and other components, studio and transmission equipment, peripheral equipment, etc., to say nothing of the development of programming and software for HDTV applications. Rapid commercialization and deployment of HDTV technologies will create additional jobs in related fields such as computers, medical imaging, factory automation, and education. In these and many other ways, rapid progress in HDTV implementation can stimulate economic growth and improve the quality of life for tens of millions of Americans.

Conclusion

The transition to a new television broadcast system is akin to a grueling marathon, but there is no clear finish line; the end of the transition is still 15 or more years away. The United States has acquired a substantial lead in this race because of technical know-how, typically American competitive instincts, and leadership in digital techniques. But to maintain our lead we must act with speed.

We earnestly ask that our proposed deadline for commencement of HDTV broadcasting be adopted as national policy. That finish line is in sight, and with effort it can be reached in a way that makes us all winners.

EIA STATEMENT OF PRINCIPLES ON ADVANCED TELEVISION FOR THE UNITED STATES

The Electronic Industries Association (EIA) is vitally interested in developing a technologically sound and commercially viable Advanced Television (ATV) policy for the United States. EIA's member companies include the leading suppliers of electronic equipment to the broadcast, cable and satellite industries as well as virtually every major manufacturer of color television products. EIA is playing a major role in the ATV standards process and the implementation of the new systems as it has for more than 65 years in the creation of most existing audio and video standards.

We believe that the successful adoption and implementation of ATV systems in the United States is very much in the interest of the American public and plays an essential role in maintaining U.S. R&D and manufacturing competitiveness in the global economy.

Toward that end, EIA supports the following principles and policies:

1. *EIA endorses the current FCC Advisory Committee and Advanced Television Test Center process for terrestrial broadcast standard testing, selection and approval.*
2. *EIA believes that ATV standard selection should be based solely on objective analysis of technical merit, economic practicality and consumer benefits.*
3. *EIA believes that the ATV standards selection should take place as soon as practicable in order to provide the American people with this new technology on a timely basis, to create U.S. export opportunities and to encourage U.S. competitiveness.*
4. *EIA supports selection of standards that are "friendly" to alternate delivery media through the use of standardized multiport interfaces where necessary.*
5. *EIA endorses the concept of U.S. Government financial support of generic advanced technology R&D within the United States.*
6. *Recognizing the emerging international consensus, EIA believes that ATV systems should have CD-quality audio and conform to the new widescreen, 16×9 aspect-ratio format.*
7. *EIA encourages domestic research and development on and production of ATV receivers and related equipment with the widest possible range of product models and features thereby extending the benefits of this new technology to the largest consumer market.*
8. *EIA endorses the continuous development of new technologies for advanced television and their adoption by all delivery media and product manufacturers as the technology and economics permit.*
9. *EIA supports legislative and administrative efforts designed to encourage low-cost capital formation, make the R&D tax credit permanent, allow joint R&D and product arrangements (appropriately defined and non-exclusionary). We also seek to gain equal access to foreign markets, eliminate export disincentives and generally create and maintain an acceptable policy environment for U.S. business expansion and economic growth.*

EIA/ATV COMMITTEE WHITE PAPER
ON THE DEVELOPMENT OF HDTV, MAY 1993

The EIA/ATV Committee, on behalf of its members and the Electronic Industries Association, urges that the 1996 Summer Olympics be established as the latest date for the simultaneous launch of terrestrial, cable and satellite broadcast HDTV to the American home.

In 1987 and 1988, the Federal Communications Commission (FCC) established an FCC Advisory Committee on Advanced Television (ATV) Service, authorized the testing of ATV proponent systems by the Advanced Television Test Center (ATTC) and began the process of developing a high-definition television (HDTV) transmission standard for the United States. In the ensuing five years, the U.S. Government and industry have worked in a cooperative joint effort to select a system for HDTV delivery. U.S. industry has invested tens of thousands of hours and hundreds of millions of dollars in the process.

The EIA/ATV Committee was formed in January 1988 to consider the broad range of public policy issues related to ATV and HDTV. Participating on the Committee are developers, manufacturers, sellers and installers of studio, broadcast, transmission and consumer equipment. The EIA/ATV Committee endorses the current FCC Advisory Committee process for testing, selecting and approving an HDTV system for the United States. EIA provides significant financial support for testing at the ATTC, and EIA and the EIA/ATV Committee have provided regular input to the FCC and the Congress on HDTV and related topics.

With the emergence of digital compression and transmission technology and the focus on terrestrial broadcasting, the United States has gained a real advantage in HDTV technology over that being deployed or considered elsewhere in the world. Each of the remaining four proponent systems in the FCC review process is digital.

Prototype HDTV equipment was designed and developed by the proponents, tests were designed by hundreds of industry experts, and the systems were tested in 1992. Advisory Committee Chairman Richard Wiley and FCC Chairmen Dennis Patrick, Alfred Sikes and James Quello have all shown visionary leadership in keeping the HDTV decision process on track.

Recently, the remaining four proponents announced the formation of a "Grand Alliance" in order to propose a single "best-of-the-best" system to the FCC Advisory Committee. The Grand Alliance is a welcome development because it should enable the U.S. to adopt an effective standard expeditiously. There is a critical need to establish the U.S. HDTV transmission standard as soon as possible so that implementation activities can begin.

We are committed to working with the government to achieve this important goal because:

- Jobs Are at Stake. The early introduction of HDTV will create jobs in the United States and stimulate the U.S. economy. At a minimum, HDTV will create jobs for American workers in the design and manufacture of HDTV displays, integrated circuits and other components, studio and transmission equipment, peripheral equipment, etc., as well as in the development of programming and software for HDTV applications. The early introduction of HDTV also will benefit consumers, create export opportunities for U.S. companies and promote U.S. competitiveness.

- The U.S. Lead Is at Stake. By all accounts, the United States is the world leader in high-definition technology because of the success of digital proponents. To maintain the lead we must act with speed. Foreign competition can be expected to introduce one or more digital HDTV standards in the near future. If the U.S. acts expeditiously, other countries will be motivated to adopt all or part of the U.S. technology in establishing their standards. If the U.S. delays its decision, we risk losing our technological lead and allowing foreign competitors to establish preeminence in the marketplace. The rapid establishment and commercialization of U.S. digital high-definition television technologies will be the engine that drives developments with a significant impact -- not only on home entertainment but also on other industries, including computer and medical imaging, factory automation, and education.

To maintain its competitive advantage, the United States must move forward with the adoption of an HDTV transmission standard and target the Summer Olympics 1996 as the latest date for commencing HDTV delivery to American homes. For their part, the undersigned and their members are prepared to work with the U.S. Government and to expeditiously produce the components and end products necessary to reach that goal.

Peter F. McCloskey, President
Electronic Industries Association

Sidney Topol, Chairman
EIA/ATV Committee

Allen R. Frischkorn, President
Telecommunications Industry
Association

TESTIMONY

SUBMITTED FOR THE RECORD
FOR THE HEARING
ON

HIGH DEFINITION INFORMATION SYSTEMS

House Committee on Science, Space and Technology
Subcommittee on Technology, Environment and Aviation

103rd Congress

Testimony of John Diebold
on the High Performance Computing
and High Speed Networking Applications Act of 1993
H. R. 1757
Submitted to the House Subcommittee on Science

I am John Diebold, Chairman, The Diebold Institute for Public Policy Studies.

The Diebold Institute is a small operating foundation which has been studying the public policy issues relevant to information-based societal infrastructure for the past two years. I have contributed a large part of my own time to this study which has been funded primarily by the Alfred P. Sloan Foundation.

We applaud the leadership of Congressman Boucher as the author of H.R. 1757 which is intended to advance the development of a National Information Infrastructure. We submit the following suggestions for strengthening this legislation:

A Totally Different Approach to the Delivery of Societal Services is Now Possible

Computers and communications, with the continuing decline in the unit cost of this technology and continued improvement in interface capabilities allowing for easy use by the average and untrained person, has the potential for a totally different approach to delivering those services which are usually considered part of society's infrastructure. Many of the restrictions of the past need no longer apply:

- The receiver of the service, the provider, and all of the required equipment no longer need to be located at the same location. This means that cars, homes, offices, schools, shopping centers, etc., both local and out-of-town, are now appropriate locations for dispensing societal infrastructure services, and resources can be more highly utilized. Under-populated areas can also be served cost-effectively.

- Payment for the use of a societal infrastructure will be accomplished without immediate post-usage queuing or even a separate and later invoicing/payment activity but can be automatic. Thus, the possibilities for pay-for-use are enhanced.

- Decisions concerning each receiver of societal infrastructure services need no longer be made in a vacuum but can easily consider both the particular recipient's history and the needs and actions of all of the other individuals who are involved or impacted by this decision. The ability of the decision making processes to be refined automatically and to learn continuously from previous experience is now also possible.

- Traditionally separate infrastructures can be linked (for example, health care with emergency services, highways with hazardous waste tracking). Infrastructure and commercial activity can be linked (for example, societal air quality surveillance and company specific emission control systems).

- To the extent it is desirable, uniformity can be achieved. Likewise, the ability to differentiate based on the circumstances of each particular situation can as easily be achieved. Special provisions can be made for individuals with special needs (for example, the handicapped). Language can be at the user's choice. Normal business hours need not be a restriction. Where fast response is necessary, it can be achieved. Fraudulent use, including organized fraudulent use, can be detected.

- Job opportunities within societal infrastructures can command the same respect and compensation as other information intensive areas of our economy.

Agreement with Application Focus, but There is a Need to Emphasize Institutional Issues

We certainly concur that an applications focus is important in advancing the use of information technology in support of societal infrastructure. When the applications are available and in demand, the networks to support these applications will be made available by the private sector.

However, creating and deploying these applications faces a number of obstacles. It is not really a question of using information technology to automate that which previously was unautomated, but rather to reinvent the infrastructure to take advantage of new ways of providing the service. This generally requires a reorganization of both the institutions comprising the infrastructure and the way that those served interface with the infrastructure. Such changes are not easy and will take time. H.R. 1757 should have sufficient provisions for understanding these institutional issues. Perhaps this needs to be dealt with more explicitly in H.R. 1757.

Need for Private Sector Participation

The need for the private sector to participate in applying information technology to infrastructure is fairly well accepted. Although there may not be unanimity on this, most observers mention some combination of:

- Interest in and ability to take the risks associated with a new approach

- Experience in developing new markets

- A source of capital

- A focal point for the multitude of governmental and quasi-government organizations whose support must be gained for the information infrastructure supporting the societal infrastructure (we call this "infostructure") to proceed first in each geographical area and ultimately nationwide.

- A way of moving decisions on priorities and pricing from the political arena to the economic arena

Creating and operating infostructure does not generally fall within the mission nor skill base of existing infrastructure institutions. For example, in health care there is no health care institution within most communities comfortable with assuming the role of supplier of information services and manager of information exchange for all health care product in the community. Although it may be possible to grow new organizations and skills within the spectrum of institutions associated with each traditional infrastructure, it will be far faster to accomplish this through entrepreneurial activity from the private sector.

Notwithstanding the general agreement on the virtues of private sector involvement, there is little understanding of what is required to encourage substantial private sector involvement particularly in the more entrepreneurial roles as opposed to simply responding to RFP's and offering products to already demonstrated markets.

To understand what it takes to gain more private sector involvement and to bring about such increased participation, H.R. 1757 should provide for extensive first hand analysis of what is involved. Those whose points of view need to be solicited would include:

- Various categories of companies whose participation would be desirable

- Public finance individuals and organizations
  - Academics
  - Financial institutions

- Public authorities with whom the private sector would need to cooperate

Need For Broader Definition of Infrastructure Application Areas

H.R. 1757 currently refers specifically to education, libraries, health care, and the provision of government information. There is also a reference to "other" appropriate fields.

The Diebold Institute has been looking at the opportunities for information technology to reinvent many other societal infrastructures including:

Transportation

Power and fuel distribution

Entertainment/Public Information

Environmental Protection

Public Safety

Mail

There may be some advantage to broadening the focus of H.R. 1757 to include these additional infrastructures. However, care must be taken to avoid the unintended consequence of having the apparatus established to implement H.R. 1757 interfere with existing activities taking place in these other infrastructures.

Need For Coordination

The High-Performance Computing Act of 1991 called for the establishment of an advisory committee to facilitate the coordination of governmental, academic and private sector initiatives. In this regard, we would recommend review of the approach taken with respect to the vehicle infrastructure, name the Intelligent Vehicle Highway Society of America, which we believe has been very successful.

Need for Demonstration Projects

It is only by doing that we can learn how the greatest benefits can be achieved. Success begets success and an active program of demonstration projects can mushroom into something much larger without massive governmental expenditures.

H.R. 1757 provides for demonstration projects which develop and apply computing and high-speed networking technologies for us in the various infrastructures. It is important that these demonstration projects:

- Go beyond to network and computer technologies demonstrations and place greater emphasis on the specific application functionality that will reinvent the infrastructure.
- Focus ont he institutional issues including private sector participation that will be the primary determinant of the ability to go beyond technical feasibility to acceptance and deployment.
- Establish quantitatively the cost and benefits of ultimate deployment, and disseminate these results to interested parties.

Need for an International Perspective

Much is happening in Europe and the Pacific. Learning from their experience, and having them learn from our experience, helps us all move ahead faster. A mechanism for identifying the most important efforts abroad and seeding these here, is a low-cost way of moving ahead more rapidly.

Look Ahead to Infrastructure Funding Legislation

One way to advance the deployment of information technology in infrastructure is to call for the attainment of specified technology milestones, (e.g., levels of dissemination, compliance with technical standards) in all legislation which funds infrastructure including legislation which is normally thought of as being totally separate from H.R. 1757.

The Plan for Computing and Networking Applications which will be prepared at least once each two years as a result of H.R. 1757 should address how such milestones and levels of dissemination can be usefully incorporated in other infrastructure funding legislation.

The Diebold Institute for Public Policy Studies appreciates the opportunity to provide our testimony on H.R. 1757 and we look forward to further opportunities to provide input on this subject.

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